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Source Control Evaluation for the Premier Edible Oils Site

Portland, Oregon

Prepared for
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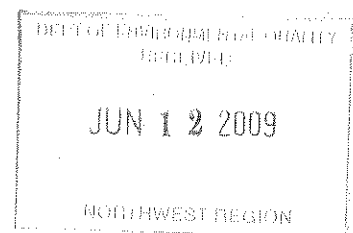


Table of Contents

	<u>Page</u>
1 Introduction.....	1
2 Site Background.....	4
2.1 Physical Setting.....	4
2.1.1 Stormwater and Surface Water.....	5
2.1.2 Geology and Hydrogeology.....	6
2.1.2.1 Stratigraphy.....	6
2.1.2.2 Groundwater.....	7
2.2 Site Ownership History.....	10
2.3 Site Operational History.....	10
2.3.1 PEO Site.....	11
2.3.2 Former Bell Terminal Tank Farm Area.....	12
2.4 Land and Beneficial Water Use Evaluations.....	13
3 Potential Source Areas.....	14
3.1 Area Primarily Impacted by Time Oil's Bell Terminal Tank Farm (Central PEO Site).....	15
3.1.1 Surface Soil.....	17
3.1.2 Soils at Depth.....	19
3.1.3 Groundwater.....	22
3.1.4 LNAPL.....	24
3.1.5 Sediment.....	25
3.2 Area Primarily Impacted by Former Northwest Oil Co. Tank Farm (Southern PEO Site).....	28
3.2.1 Surface Soil.....	29
3.2.2 Soils at Depth.....	32
3.2.3 Groundwater.....	34
3.2.4 LNAPL.....	35
3.2.5 Sediment.....	36
4 Potential Migration Pathways.....	40
4.1 Groundwater.....	40
4.1.1 Area Primarily Impacted by Time Oil's Bell Terminal Tank Farm (Central PEO Site).....	40
4.1.2 Area Primarily Impacted by Former Northwest Oil Co. Tank Farm (Southern PEO Site).....	41
4.2 LNAPL Transport.....	41
4.2.1 Area Primarily Impacted by Time Oil's Bell Terminal Tank Farm (Central PEO Site).....	41
4.2.2 Area Primarily Impacted by Former Northwest Oil Co. Tank Farm (Southern PEO Site).....	41
4.3 Overland Transport/Sheet Flow.....	42
4.4 Bank Erosion.....	43

DRAFT

4.5	Stormwater	43
4.6	Overwater Activities	45
4.7	Other	45
5	Site Data Screening Using JSCS Screening Level Values	46
5.1	Groundwater in the Area Primarily Impacted by Time Oil's Bell Terminal (Central PEO Site)	47
5.2	Groundwater in the Area Primarily Impacted by the Former Northwest Oil Co. Tank Farm (Southern PEO Site) Groundwater	48
6	Conclusions / Recommendations	51
6.1	Groundwater	51
6.1.1	Area Primarily Impacted by Time Oil's Bell Terminal (Central PEO Site)	51
6.1.2	Area Primarily Impacted by the Former Northwest Oil Co. Tank Farm (Southern PEO Site)	51
6.2	LNAPL	52
6.2.1	Area Primarily Impacted by Time Oil's Bell Terminal (Central PEO Site)	52
6.2.2	Area Primarily Impacted by the Former Northwest Oil Co. Tank Farm (Southern PEO Site)	52
6.3	Overland Transport/Sheet Flow	53
6.4	Bank Erosion	53
6.5	Stormwater	53
6.6	Overwater Activities	54
6.7	Other	54
	References	55
Appendix A	Bank Photos	
Appendix B	Migration Calculations	
Appendix C	Site Data Screening Using JSCS Screening Level Values (SLVs)	
Appendix D	October 2001 Groundwater Elevation Data (Tidal Fluctuations)	

List of Abbreviations and Acronyms

AST	Above Ground Storage Tank
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	Cubic Feet per Second
COP	City of Portland, Oregon
CSM	Conceptual Site Model
d/b/a	Doing Business As
DEQ	Oregon Department of Environmental Quality
Gradient	Gradient Corp.
JSCS	Joint Source Control Strategy
LNAPL	Lighter-than-water Non-Aqueous Phase Liquid
LWG	Lower Willamette Group
MCL	Maximum Contaminant Level
MSL	Mean Sea Level
NGVD	National Geodetic Vertical Datum
NPDES	National Pollutant Discharge Elimination System
OSC	Oregon Shipbuilding Corp.
PAH	Polycyclic Aromatic Hydrocarbon
PEO	Premier Edible Oils
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
RM	River Mile
ROD	Record(s) of Decision
SCE	Source Control Evaluation
SCM	Source Control Measure
SIC	Schnitzer Investment Corp.
SLV	Screening Level Value
SVOC	Semivolatile Organic Compound
Work Plan	August 2006 <i>Work Plan for Additional Characterization of the Premier Edible Oils Property</i>
TCE	Trichloroethene
TPH	Total Petroleum Hydrocarbon
USMA	US Maritime Administration
US EPA	US Environmental Protection Agency
VOC	Volatile Organic Compound
WTE	Water Table Elevation

DRAFT

List of Tables

Table 3.1	Summary of TPH and Total PAH Concentration Data in Central PEO-Area Sediment Samples from LWG Field Sampling Program and Reports (mg/kg)
Table 3.2	Summary of TPH and Total PAH Concentration Data in Central PEO-Area Sediment Samples near Outfall 1 (mg/kg)
Table 3.3	Summary of TPH and Total PAH Concentration Data in Southern PEO-Area Sediment Samples from LWG Field Sampling Program and Reports (mg/kg)
Table 3.4	Summary of TPH and Total PAH Concentration Data in Central PEO-Area Sediment Samples near Outfall 2 (mg/kg)
Table 5.1	Conservative Estimates of Mass Discharge of BTEX and PAHs in Groundwater to the Willamette River
Table 6.1	Source Control Evaluation Summary

List of Figures

Figure 2.1	PEO Site Location Map
Figure 2.2	Key Site Features
Figure 2.3	PEO Site Containment and Drainage Map
Figure 2.4	Subsurface Cross-Section Key
Figure 2.5	Cross Section A-A'
Figure 2.6	Cross Section B-B'
Figure 2.7	Cross Section C-C'
Figure 2.8	Cross Section D-D'
Figure 2.9	Cross Section E-E'
Figure 2.10	Cross Section F-F'
Figure 2.11	Site-Wide WTE Contours – 2008 and 2009
Figure 2.12	2008 WTE Contours Tidal Comparison – February vs. November
Figure 2.13	February 2008 Tidal Survey WTE Contours at 6 Hour Intervals
Figure 2.14	November 2008 Tidal Survey WTE Contours at 6 Hour Intervals
Figure 3.1	Relative Petroleum Product Storage Capacity at the PEO and Bell Terminal Sites
Figure 3.2	Surface Soil Analytical Results Focused Site Characterization Study (Bridgewater Group, 1998)
Figure 3.3	Surface Soil Analytical Results Remedial Investigation (Bridgewater Group, 2001)
Figure 3.4	TPH-Diesel Concentrations Observed in Soil at Depth (mg/kg)
Figure 3.5	TPH-Gasoline Concentrations Observed in Soil at Depth (mg/kg)
Figure 3.6	Assessment of Capillary Fringe Zone Soil Results – TPH-Diesel (mg/kg)
Figure 3.7	Assessment of Capillary Fringe Zone Soil Results – TPH-Gasoline (mg/kg)
Figure 3.8	TPH-Gasoline and TPH-Diesel Concentrations in Groundwater (mg/L)
Figure 3.9	Product Observation in Monitoring Wells
Figure 3.10	Comparison of Chromatograms Illustrating Diesel Composition for the Bell Terminal and PEO Properties
Figure 3.11	TPH and PAH Compounds in Sediment Samples Collected Near the PEO Site
Figure 4.1	PEO Site Containment and Drainage Map with Surface Soil Sampling Results
Figure 4.2	Shoreline Conditions and Photo Locations
Figure 5.1	Summary of Results of Initial Screening Against JSCS SLVs – PAH Compounds in Groundwater
Figure 5.2	Summary of Results of Initial Screening Against JSCS SLVs – BTEX Compounds in Groundwater
Figure 5.3	Summary of Results of Initial Screening Against JSCS SLVs – Metals Compounds in Groundwater

1 Introduction

On behalf of Schnitzer Investment Corp. (SIC), Gradient Corp. (Gradient) has prepared this Source Control Evaluation (SCE) Report for the Premier Edible Oils (PEO) site. In accordance with the objectives specified in the Portland Harbor Joint Source Control Strategy (JSCS) (DEQ and US EPA, 2005), this report focuses on identifying and evaluating sources of contamination at the PEO site that may reach the Willamette River at levels that may present a risk to human or ecological receptors. This SCE report is one component of the ongoing efforts conducted by SIC at the PEO site in compliance with the Voluntary Agreement for Upland Remedial Investigation/Feasibility Study (RI/FS) and Source Control Measures (SCMs) between SIC and the Oregon Department of Environmental Quality (DEQ), effective March 1, 2001. This report has been prepared as requested by DEQ in a series of communications with SIC, including those reflected in the August 2006 *Work Plan for Additional Characterization of the Premier Edible Oils Property* (Gradient, 2006a; as amended in an October, 2007 letter [Gradient, 2007], and approved by DEQ on November 14, 2007 [DEQ, 2007]).¹

According to DEQ and the US Environmental Protection Agency (US EPA), "[t]he overarching goal of the Portland Harbor JSCS is to identify, evaluate, and control sources of contamination that may reach the Willamette River in a manner that is consistent with the objectives and schedule of the Portland Harbor RI/FS (DEQ and US EPA, 2005)." The major components of the process described by DEQ and EPA include identifying contaminant source areas, evaluating whether there are complete migration pathways between source areas and the Willamette River, and – where migration pathways are complete – determining whether contaminants are reaching the river at levels of concern. The JSCS documentation identifies numerical Screening Level Values (SLVs) that are to be applied in the Source Control process to develop a preliminary assessment of contaminant levels in soil and water reaching the Willamette River that may need additional evaluation (DEQ and US EPA, 2005). In accordance with the process described in the JSCS, evaluation of the need for SCMs is conducted using a weight-of-evidence approach, *i.e.*, exceedance of an SLV does not necessarily indicate a need for SCMs. The JSCS documentation also states that the Record(s) of Decision (ROD) that will be prepared for the Portland Harbor Superfund site

¹ The objectives and scope of work for the Work Plan reflect the outcomes from a series of communications between DEQ and SIC, including meetings in December 2003, August 2004, January 2005, and May 2006; a March 2004 memorandum prepared by Gradient on behalf of SIC recommending additional data collection efforts for the southern portion of the PEO site (Gradient, 2004a); an October 2004 letter from DEQ requesting additional sampling for the southern and central portions of the PEO site (DEQ, 2004); and other communications. The process of developing the Work Plan and obtaining DEQ approval of the Work Plan also was significantly prolonged by multiple changes in DEQ project management staffing for the PEO site over the 2004-2007 time period.

202017

by US EPA will establish site-specific cleanup levels that will help guide SCMs. Currently available information indicates that the Portland Harbor ROD(s) may not be available until 2011-2012.

The PEO property is an 18.5-acre industrial property located within an industrial area adjacent to the Willamette River. Between 1973 and 1996, PEO processed edible vegetable oils – such as palm and cottonseed oils – on the property (Bridgewater Group, 1998; AGRA, 2000). For several years during World War II, the site was part of a federal shipbuilding facility. Between 1941 and 1943, the Northwest Oil Co.² owned and operated an above-ground petroleum storage facility in the southern portion of the site which included 7 vertical above-ground storage tanks (ASTs) and several horizontal ASTs (Bridgewater Group, 2000a; 2000b) with the capacity to store approximately 3 million gal of petroleum products (Brown, 2008). Although SIC has owned the property since 1972, it has never occupied or operated on the site. Additional information regarding site background and use is discussed in Section 2 (*Site Background*).

This Source Control Evaluation relies upon extensive past investigations undertaken at the site including Phase I and II Environmental Site Assessments (Hanson Engineers, 1996; AGRA, 1996), a Focused Site Characterization (Bridgewater Group, 1998b), and numerous sampling events undertaken by SIC as part of remedial investigation (RI) work, including the recently completed investigations implementing the scope outlined in the DEQ-approved August 2006 *Work Plan for Additional Characterization of the Premier Edible Oils Property* (the Work Plan; Gradient, 2006a; 2007; DEQ, 2007). The RI work has included soil and groundwater sampling at the PEO site and selected locations in the western portion of Time Oil's Bell Terminal site (Bridgewater Group, 2001a; 2001b; 2002; Gradient, 2002; 2003; 2008; 2009). The Bell Terminal facility is the location of a former petroleum product storage and transfer facility with more than 12 million gal of storage capacity. This facility started operations in 1953 and operated for approximately 50 years, handling gasoline, diesel, and other products (Landau, 2001). Data collected at the PEO and Bell Terminal properties, as well as other relevant supporting information, indicate that releases and migration of petroleum product contamination from sources on the Bell Terminal property and sources associated with the former Northwest Oil Co. petroleum product storage facility are likely significant sources of contamination observed at the PEO site (e.g., US EPA, 2005; Gradient, 2006b; DEQ, 2009b).

² Available information indicates that the Northwest Oil Co. was a predecessor company to Time Oil. See, e.g., TOC Holdings Co., 2008; LWG, 2004b.

The analyses presented in this report indicate that groundwater transport is the only potentially complete pathway of any significance for contaminant migration to the Willamette River identified for the PEO site. In particular, comparisons of site data with the conservative SLVs prescribed by the JSCS documentation reveal the potential for selected individual petroleum hydrocarbon constituents measured in groundwater from the southern portion of the PEO site to discharge to the Willamette River, albeit at relatively low levels. Based on comparison with the JSCS SLVs, petroleum hydrocarbon-related contaminants in groundwater from the central area of the PEO site are not currently reaching the river at concentrations that are greater than the SLVs. Other potential transport pathways – such as overland transport/sheet flow, bank erosion, stormwater, and overwater activities – either do not exist for this site or are unlikely to present any significant potential for contaminant transport to the river. Similarly, evaluations of petroleum LNAPL at the site provide no evidence that such product is currently being transported to the river; however, additional evaluations of source control measures for this LNAPL have been identified to prevent the product from serving as a source of dissolved contaminants to groundwater. Other recommendations for additional evaluations and site monitoring that are identified in this report include conducting periodic product monitoring in the southern portion of the PEO site, re-evaluating metals concentrations in groundwater when site-specific background concentrations and risk assessment analyses are developed, and establishing institutional controls addressing selected aspects of stormwater transport and overwater activities.

Following a brief introduction to site features and history in Section 2, this report addresses the source control evaluation elements prescribed in the JSCS documentation: identification and characterization of source areas (Section 3); evaluation of contaminant transport pathways from source areas to the Willamette River (Section 4); screening of relevant observed chemical concentrations with prescribed JSCS SLVs for potentially complete pathways (Section 5); and conclusions and recommendations (Section 6). However, until compliance benchmarks are provided through the US EPA Portland Harbor ROD(s), any conclusions regarding the potential need for SCMs based on JSCS SLVs are preliminary and subject to revision.

2 Site Background

2.1 Physical Setting

The 18.5 acre PEO site is located on the Portland Harbor waterfront at 10400 North Burgard Way, Multnomah County, Portland, Oregon (Bridgewater Group, 1998b).³ Figure 2.1 shows the site location. The site is zoned for heavy industrial use (PortlandMaps.com, 2009), but is currently mostly vacant (see Figure 2.2). Bulk petroleum terminals abut the site to the north (Time Oil's Main Tank Farm, which began operations in 1943) and northeast (Time Oil's Bell Terminal, which began operations in 1953). A corrugated cardboard container manufacturing facility owned by Jefferson Smurfit abuts the site to the southeast. The Willamette River and a boat slip currently known as the International Terminals slip comprise the western and southern borders of the site, respectively. The International Terminals slip is a man-made feature initially created by dredging in the 1940s (see Section 2.3 for more details).

Most of the site is relatively flat, with ground surface elevations ranging from approximately 27 to 30 ft above Mean Sea Level (MSL) relative to the City of Portland, Oregon (COP) vertical datum.⁴ A topographic low spot is present in the northern portion of the site, where the ground surface was regraded during the 1999 removal and demolition of an AST farm for edible oils, which was part of the PEO processing facility located here (Bridgewater Group, 2001a). A steep 10 - 15 ft bank on the western and southern site borders slopes down to the Willamette River and International Terminals slip shore lines, and a flatter "beach" is present at the bank's base which also slopes down to the water (see, e.g., bank surveys presented in Gradient, 2009). The beach and bank are seasonally inundated during periods of high river stage (during late winter and early spring). Recent (October 2008) photos of the shoreline are included as Appendix A.

Portland's climate is considered west coast marine, with moderate annual rainfall averaging 36 inches for the period of record (1940 - 1990). Most precipitation is rain, with an average of only four days per year of measurable snow. Monthly average precipitation ranges from 0.6 in (July) to 6 in (December), with almost 50% of the annual average precipitation occurring from November through

³ The 18.5 acres include 6 acres under water and 2 acres of river bank/shoreline.

⁴ Except as noted, all elevations in this report are relative to the COP vertical datum. To convert to NGVD29, subtract 1.38 ft from COP. (NGVD: National Geodetic Vertical Datum).

202017

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January and almost 90% of the annual rainfall occurring from October to May. The maximum 24-hr precipitation rate for the period of record is 10.6 in (which occurred in January 1950). The average annual temperature is 53.6°F, ranging from a monthly average of 39.6°F in January to 68.6°F in August. The annual mean wind velocity is 8 mph from the northwest (during spring and summer) and east-southeast (during fall and winter) (NOAA, 2009).

2.1.1 Stormwater and Surface Water

Stormwater from the PEO site was historically discharged to the Willamette River or International Terminals slip under a National Pollutant Discharge Elimination System (NPDES) permit *via* Outfalls 1, 2, and 3 or discharged to the city sanitary sewer lines according to COP permit requirements (Bridgewater Group, 2001a; SIC, 2008). Based on information provided by PEO, no NPDES or other compliance violations were noted against the PEO facility (Hanson, 1996). Stormwater discharges to Outfalls 1 and 2 (which discharged to the Willamette River) were eliminated in 2001 (Bridgewater Group, 2001a). As shown on Figure 2.3⁵, several catch basins in the southern PEO site continue to drain to Outfall 3, which is located on the adjacent Jefferson Smurfit property and discharges to the International Terminals slip. Other pertinent drainage features depicted on Figure 2.3 include a large diked area in the central portion of the PEO site which previously housed an edible oil tank farm, and approximately 40% (210,000 sq ft, or about 5 acres) of the upland PEO site surface is relatively impervious material consisting of asphalt or concrete.

The PEO site is located between River Mile (RM) 3 and RM 4 of the Portland Harbor section of the Willamette River. According to documentation of investigations of the Portland Harbor Superfund site prepared by the Lower Willamette Group (LWG) (LWG, 2007), Portland Harbor extends upstream from the Columbia River (RM 0) to the Broadway Bridge (RM 11.7) as defined by the extent of federal dredging of the main navigational channel.⁶ The tidally-influenced Willamette River flows north past the site, discharging into the Columbia River at RM 0 after receiving flow from the Multnomah Channel – which is approximately 0.5 mi north of the site. The Willamette River is the thirteenth-largest river (by discharge) in the mainland United States, averaging approximately 40,000 cubic feet per second (cfs). Discharge is seasonally variable by up to an order of magnitude, with late-summer low discharges of approximately

⁵ A storm sewer system smoke test and inspection was completed in October 2008 to define the current drainage features. Gradient (2009) provides additional details regarding this investigation.

⁶ The Portland Harbor Superfund Site extent has not yet been formally defined, but the Portland Harbor Superfund Site "Study Area" has been defined as extending from RM 2 to RM 11 (LWG, 2007).

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10,000 cfs and winter high discharges of about 100,000 cfs. The annual low water levels occur during the regional dry season from August to November. Winter (November to March) river stage is relatively high but variable due to short-term changes in precipitation levels in the Willamette basin. Large discharge events of 200,000 cfs occur every few years and can cause flooding. The two highest peak storm flows on record were during the winters of 1996 and 1997, reaching 420,000 cfs and 290,000 cfs, respectively (LWG, 2007).

2.1.2 Geology and Hydrogeology

2.1.2.1 Stratigraphy

Shallow subsurface stratigraphy beneath the PEO site has been well-defined by approximately 78 soil borings, 9 test pits, and 24 monitoring wells which have been installed during environmental investigations. Most locations have been installed to depths of 30 ft below ground surface (bgs) or less. Subsurface stratigraphy beneath Time Oil's abutting tank farms has also been defined and is pertinent to analyses of the PEO site because the Time Oil tank farms are hydraulically upgradient and Time Oil facilities were primary contributors to PEO site contamination. Deeper strata (*i.e.*, below the alluvium) are described based on regional geology and are not directly relevant because they are deeply sequestered from the shallow petroleum-related contamination at the PEO Site.

In order of increasing depth bgs, the PEO site is underlain by the following strata:

- Fill – Silty gravel deposits at and near the ground surface associated with construction and early 1900s filling with river dredge spoils for land reclamation (Bridgewater Group, 2001a; 2001b).
- Alluvium – Sand and silt deposits extending up to 180 ft bgs. A series of discontinuous silt/clay lenses is present at depths of approximately 20 - 30 ft bgs beneath the PEO site. These lenses transition into a continuous confining layer beneath Time Oil's Bell Terminal to the east. The water table aquifer is located within shallow alluvium at depths of approximately 15 - 25 ft bgs.
- Sandy River Mudstone and Troutdale Formation – Sedimentary deposits which originated from ancient fluvial and volcanic rock weathering, consisting of fine-grained mudstone and conglomerate/fine-grained deposits, respectively. The Troutdale Formation is extensive within Portland Basin.
- Columbia River Basalt – Bedrock, folded and faulted, encountered at approximately 1,800 ft deep and up to 700 ft thick.

A series of cross-sections depicting subsurface conditions beneath the PEO Site and Time Oil's Bell Terminal is provided as Figures 2.5 through 2.10. A plan view map showing the orientations of the cross-sections is included as Figure 2.4. Cross-sections A-A', B-B', and C-C' depict stratigraphy in the southern site, while cross-sections D-D', E-E', and F-F' depict conditions in the central and northern site extending off-site beneath Bell Terminal. Some key observations from these cross-sections include:

Southern Site

- The alluvium layer is mostly sand with varying, lesser amounts of silt and clay lenses.
- A discontinuous series of silt, clay, and silty sand lenses was consistently encountered at an elevation of 0 to 10 ft MSL, which corresponds roughly to the smear zone.
- The surficial fill layer was observed in nearly all locations with greatest thicknesses adjacent to the Willamette River shoreline.
- The water table was encountered at depths of 20 to 25 ft bgs corresponding to elevations of 0 to 10 ft MSL.

Central Site (including Time Oil's Bell Terminal)

- The alluvium layer is mostly sand with varying, lesser amounts of silt and clay lenses.
- Cross-section E-E' (Figure 2.9) shows the topographic depression at the former location of PEO's edible oil AST farm.
- Cross-section D-D' shows the discontinuous confining lenses beneath the PEO Site transitioning eastward into a 5 - 10 ft thick confining layer. The transition begins at approximately the area where PEO's former 10,000-gal diesel AST was located, with the confining layer continuous beneath Time Oil's Bell Terminal. This confining layer is also shown in cross-section F-F' (Figure 2.10). Based on the depictions in cross-sections D-D' and F-F', the confining layer surface undulates but there is no clear slope direction.
- Groundwater is perched above this confining layer beneath Bell Terminal at depths of 13 to 18 ft bgs corresponding to elevations of 10 to 15 ft MSL. A deeper zone of groundwater is present beneath the confining layer.

2.1.2.2 Groundwater

The PEO site is underlain by a tidally-influenced unconfined water table aquifer which occurs at depths ranging from approximately 15 to 25 ft bgs. This single unconfined aquifer beneath the PEO Site splits into a shallow and deep zone beneath Time Oil's Bell Terminal. Groundwater in both zones flows west/southwest from Time Oil's Bell Terminal to the PEO Site discharging to the Willamette River.

Based on 6 rounds of water table elevation (WTE) monitoring in 2008 and 2009 (including two 48-hr tidal surveys in February and November 2008) presented in Gradient's 2009 *Additional Characterization Data Report*, groundwater flows southwest towards the river at a mean velocity of approximately 0.5 to 6 ft/day except during a period of seasonal reversal due to high river stage. During this period of seasonal reversal (observed in November 2008 and January 2009), the groundwater flow direction was reversed, *i.e.*, groundwater was observed to be flowing northeast from the river toward the PEO site at a velocity of approximately -0.3 to -4 ft/day.⁷

Figures 2.11 and 2.12 depict WTE contours for the 6 rounds of 2008/2009 measurements. Average WTEs at each well are shown for the 2 48-hour tidal surveys. Figures 2.13 and 2.14 depict WTEs at each measured well at approximately 6-hour intervals throughout the duration of the 2 48-hour tidal surveys. In all four of these figures, observed WTEs have been adjusted, where applicable, for the presence of free product using Archimedes' principle (US EPA, 1998, p.C2-8):

$$CDTW = MDTW - \frac{\rho_{\text{hapi}}}{\rho_w} (PT) \quad \text{eq. C.2.1}$$

Where:

$CDTW$ = corrected depth to water [L]

$MDTW$ = measured depth to water [L]

ρ_{hapi} = density of the LNAPL [ML⁻³]

ρ_w = density of the water, generally 1.0 [ML⁻³]

PT = measured LNAPL thickness [L]

Using the corrected depth to water, the corrected ground-water elevation, CGWE, is given by:

$$CGWE = \text{Datum Elevation} - CDTW \quad \text{eq. C.2.2}$$

The notes to these figures provide details on the hydrogeological methods used to generate the WTE contours, approximate flow directions, and velocities. These methods are further described in resources such as Domenico and Schwartz (1998) and US EPA (1998).

Some key observations on the occurrence and flow of groundwater based on these data include:

- The groundwater flow direction was southwest toward the Willamette River at all times except for November 2008 and January 2009, when river stage was high relative to

⁷ The negative sign indicates a groundwater flow direction away from the river.

groundwater elevations. At these two times, groundwater flow reversed away from the river toward the site. See Figures 2.11 and 2.12.

- Groundwater from Time Oil's Bell Terminal appears to flow southwest beneath the PEO Site. This can be confirmed based on simultaneous WTE measurements from Bell Terminal and the PEO site. Coordinated WTE data were collected on March 12, 2009. The data collected by Schnitzer's consultants during that sampling event have been incorporated into this report. Schnitzer has not yet received the WTE data collected by Time Oil's consultants during that sampling event, but will incorporate those data into future PEO site analyses when they become available. See Figure 2.11.
- The magnitude of the average hydraulic gradient was relatively constant over time, ranging from 0.01 to 0.02 (regardless of direction). See Figures 2.11 and 2.12.
- The steepest horizontal hydraulic gradients were observed southwest of Time Oil's Bell Terminal where the shallow and deep zones separated by the clay confining layer discharge to the single unconfined aquifer beneath the PEO Site. This observation confirms groundwater flow from Time Oil's Bell Terminal to the PEO site. Steep gradients can be seen on Figure 2.11 in August 2008, February 2009, and March 2009 as the relatively close contour line spacing compared to the line spacing closer to the river.
- The range of estimated groundwater velocity was relatively constant as well, *i.e.*, 0.5 to 5 ft/day to 0.6 to 6 ft/day. See Figures 2.11 and 2.12. Additional sampling to define site-specific porosity and hydraulic conductivity would allow better estimation of discrete velocities *versus* a range of velocities.
- The seasonal range of average WTEs⁸ during 2008 and 2009 was approximately 6.2 to 12.3 ft. Interestingly, the lowest and highest average WTEs were in the 2 monitoring rounds when the groundwater flow direction reversed; *i.e.*, 6.2 ft was observed in November 2008 and 12.3 ft was observed in January 2009, respectively. The other 4 rounds had closely grouped average WTEs, within 0.5 ft of each other (from 8.4 - 8.7 ft). See Figures 2.11 and 2.12.
- The average site-wide WTE⁹ varied from 0.5 to 0.9 ft in the November 2008 and February 2008 tidal surveys, respectively, indicating daily as well as seasonal fluctuations in water table elevation. The maximum observed tidal variation was observed at MW-9 in both rounds (2.0 and 1.9 ft, respectively). See Figures 2.13 and 2.14.
- During the tidal surveys, there was no reversal of groundwater flow direction observed.
 - A positive velocity (towards the river) was maintained for the duration of the February 2008 tidal survey (see Figure 2.13).

⁸ Average WTEs for a given sampling event were calculated as the site-wide arithmetic mean of the WTE measured at each monitoring well during the event (excluding deeper zone wells), corrected for free product presence. For tidal survey periods, the 48-hour arithmetic mean WTE was first calculated for each monitoring well (excluding deeper zone wells), corrected for free product presence. The time-averaged mean WTE at each well was then spatially averaged (arithmetic mean) across the site.

⁹ Based on the difference between the minimum and maximum average WTEs measured at discrete 6-hour time intervals. For tidal survey periods, the 48-hour arithmetic mean WTE was first calculated for each monitoring well (excluding deeper zone wells), corrected for free product presence. The time-averaged mean WTE at each well was then spatially averaged (arithmetic mean) across the site.

- ▶ A negative velocity (away from the river) was maintained for the duration of the November 2008 tidal survey (see Figure 2.14)

2.2 Site Ownership History

The history of ownership for the PEO site, as described in Bridgewater Group (2001a) and SIC (2008) except as noted otherwise, is briefly summarized below.

- 1865 – 1941: William Gatton or the William Gatton Estate Co.
- February 11, 1941 – December 11, 1943: Northwest Oil Co., a predecessor to Time Oil (TOC Holdings Co., 2008; LWG, 2004b).
- December 11, 1943 – 1947: US Maritime Administration (USMA)/Oregon Shipbuilding Corp.
- 1947-1950: US War Assets Administration/US General Services Administration.
- March 1950 – May 1950: Surplus Properties Corp.
- May 1950 – October 1968: Louis and Ann Dulien/Dulien Steel Products Co./William and Elizabeth Shenker d/b/a William Shenker Co.
 - ▶ 1950s: Leased by American Metallic Chemicals.
- October 1968 – 1972: Broadway Holding Co., an affiliate of Morrison Knudsen.
- 1972 – Present: SIC.
 - ▶ 1973 – January 1997: Leased by PEO, also known as PALMCO, a subsidiary of Mitsubishi Corp.
 - ▶ January 1997 – May 31, 1998: Leased by C&T Quincy Foods.
 - ▶ May 31, 1998 – Present: Property vacant.

2.3 Site Operational History

The following sections describe operations at the PEO site and the adjacent Bell Terminal property (which is upgradient with respect to groundwater flow and petroleum hydrocarbon transport), as relevant to the observed nature and extent of contamination and potential migration pathways.

2.3.1 PEO Site

Based primarily on information compiled in Bridgewater Group (2001a) and SIC (2008), operations at the PEO site included the following:

- Early 1900s: Site partially filled with river dredge spoils and other fill materials (DEQ, 2000).
- February 1941-December 1943: Northwest Oil Co. moved its oil storage terminal to the site from a former location to the south of the International Terminals slip. Facilities included seven above ground bulk petroleum tanks, a T-shaped dock on the Willamette River, and small buildings. The capacity of the facility has been estimated as approximately 3 million gallons of petroleum products (Brown, 2008). In December 1943, Northwest Oil Co. relocated their tanks northward to their current location on the adjacent Time Oil Property. Based on documentation of the February 1941 tank relocation (Oregon Shipbuilding Corp., 1945, p.11), it is likely that the December 1943 tank relocation resulted in significant releases of petroleum hydrocarbons at the southern PEO site.
- December 1943 – 1945: During WWII, USMA/Oregon Shipbuilding Corp. (OSC) Liberty shipbuilding operations expanded onto the site, as part of the war effort. Facilities included a boiler erection building (with adjacent coke storage bin), a fire brick storage building, a paint storage building, and a cable storage building. The northern portion of the site was used for bulk materials storage (types of materials unknown).
- 1945 – October 15, 1951: The defunct USMA/OSC ship yard was partially destroyed by fire, subsequently decommissioned, and ownership of the property was transferred. A 1948 flood caused extensive damage (SIC, 2008).
- October 15, 1951 – October 1956: American Metallic Chemicals operated on the site – manufacturing, packaging, and distributing chemicals, metals, and metal products. Facility equipment included a roaster, a size reduction mill, a leach tank, and three above-ground tanks (Bridgewater Group, 2001a; SIC, 2008).
- 1953: An easement was granted to Time Oil's Bell Oil Terminal (immediately east of the PEO site) to construct a pipeline from the Bell Terminal facility across the northern PEO site to the Willamette River. This pipeline was buried approximately 3 ft bgs. See Figure 2.2 for pipeline location. An associated T-shaped dock was also constructed.
- 1960s: Unknown operations under the ownership of Louis and Ann Dulien /Dulien Steel Products Co./William and Elizabeth Shenker d/b/a William Shenker Co. (SIC, 2008).
- 1973 – 1996: PEO operated an edible oil processing and storage facility on-site. Facilities included an office/processing building (including a laboratory), a hydrogen plant, a wastewater treatment facility, a maintenance shop, an AST farm for edible oil storage, an above-ground tank farm for edible oil blending, an AST farm for bulk chemical storage, a single 10,000-gallon diesel AST, and a loading facility for trucks and railcars. The T-shaped dock originally installed for the Bell Terminal was rebuilt during construction of the PEO facilities and was used for transferring edible oils to and from ships.

The underground Bell Terminal pipeline was encountered during the PEO facility construction activities in April 1973 -- resulting in an insignificant release of hydrocarbons -- and the pipeline was removed to the PEO property boundary. The exact location of the initial encounter with the pipeline is unknown. A replacement pipeline was constructed along the northern PEO site property line in 1975; however, available information indicates that use of an alternative pipeline between the Bell Terminal and the Time Oil's Main Northwest Terminal may have begun as early as 1956. Additional information regarding this event is presented in Gradient (2006b).

Other notable installations during PEO's operational period included the construction of a spill containment dike around the diesel and raw chemical storage tank farm between 1981 and 1983, the construction of a new sewer line between the office building and the maintenance shop in 1986, and the obtainment of a hazardous waste identification number by PEO in 1990 (waste streams include: ignitable wastes; corrosive wastes; spent halogenated solvents and still bottoms; and spent flammable organic solvents and still bottoms).

- 1997: C&T Quincy Foods used the site for storage.
- 1998 – Present: Site vacant. In its efforts to address the materials left at the PEO site by previous lessees, SIC removed and appropriately managed 170 gal of phosphoric acid, 170 gal of hydrochloric acid, several 5-gal containers of acetone, a 1-qt container of motor oil, and a 1-gal container of gear oil that were found on-site. Most site outfalls and catch basins were taken out of service at this time to prevent storm water from leaving the site *via* outfalls.

From 1999 to 2000, SIC completed several maintenance and demolition activities. ASTs were removed and sold or recycled; concrete beneath and around storage tanks was cleaned, excavated, and crushed; concrete from storm water management sumps was removed and crushed; crushed concrete from the above demolitions was used for fill in the southern PEO site; new utility lines were installed in the north and south tank farm areas; the maintenance shop and wastewater treatment facilities were removed; and the north and south tank farm areas were re-graded to retain storm water.

2.3.2 Former Bell Terminal Tank Farm Area

- 1953 – October 31, 2001: Time Oil Co. operated the Bell Terminal, a bulk oil terminal on the property directly east of the central PEO site. This facility included a total of 10 ASTs with a combined capacity of more than 12,000,000 gal, as well as a petroleum product loading rack and associated above- and below-ground piping network. Petroleum products stored in the tanks included diesel, gasoline, jet fuel, and ethanol (Landau, 2001; 2005; Gallagher, 1998). The tank farm facilities are currently in place at this facility; however, plans are being made to remove the ASTs from the Bell Terminal in the near future (DEQ, 2009a).

2.4 Land and Beneficial Water Use Evaluations

A formal beneficial use evaluation will be completed as part of the RI/FS, which is currently being conducted for the PEO site. For this site, beneficial land uses will likely include industrial and/or commercial uses, and beneficial groundwater uses will likely include industrial use and irrigation. For comparison, the adjoining Time Oil property is zoned heavy industrial and the likely reasonable future land use for this property is heavy industrial (Landau, 2005). Beneficial uses of shallow groundwater at the Time Oil site include industrial and irrigation use. Water supply is not considered a potential use for the Time Oil site based on low aquifer yields, and the fact that the deeper Troutdale aquifer is typically used for water supply in the Portland area (Landau, 2005). In addition, a 1999 SIC review of beneficial uses for its Lot 1 and Lot 2 of Rivergate Industrial District found similar expected uses to the Time Oil property (SIC, 1999): industrial and/or commercial land use; and industrial and irrigation groundwater uses.

3 Potential Source Areas

Potential source areas at the PEO site have been thoroughly characterized in several major rounds of environmental investigations, including a Focused Site Characterization performed in 1998 (Bridgewater Group, 1998a; 1998b) and RI efforts initiated in 2001 (Bridgewater Group, 2001a; 2001b). Site RI work has also included site-wide groundwater monitoring on 4 occasions between June 2001 and January 2003, more than 20, approximately monthly, shoreline surveys between September 2001 and December 2003, and supplemental investigations outlined in the Work Plan (which was approved by DEQ in November 2007; Gradient, 2006a; 2007; DEQ, 2007). The efforts encompassed in the Work Plan were initiated following DEQ approval of the Work Plan and the primary components of this sampling effort were completed on March 12, 2009 (Gradient, 2009). In addition, the sediments adjacent to the PEO site (and throughout the Portland Harbor) have been included in a number of investigations conducted by the LWG (LWG, 2003; 2004a; 2007; 2008). Although chlorinated solvents have been detected in a few samples within a limited area in the southern portion of the site, the primary chemicals that were detected at the site and are of concern for evaluating potential hazards and remedial needs for the PEO site are petroleum hydrocarbons. Accordingly, the following discussion focuses on issues associated with petroleum hydrocarbons.

Based on current and historical site usage and the chemical distribution patterns observed at the PEO site, site evaluations have focused on two site areas¹⁰ which have both been impacted by Time Oil's past operations on and in the vicinity of the PEO site (Figure 2.2):

- The central PEO site – Diesel- and gasoline-range total petroleum hydrocarbon (TPH) contamination is present in groundwater and soil at depth in an area extending from the eastern property boundary of the PEO site with the Time Oil Bell Terminal facility to locations to the west and southwest of the process building. As described in previous site analyses (e.g., Gradient, 2006b), petroleum hydrocarbon contamination has also been widely detected in soils at depth and groundwater throughout the central and western portion of the Bell Terminal property. This observed TPH contamination at depth continuously extends from the Bell Terminal property to the central portion of the downgradient PEO property.

¹⁰ An arbitrary dividing line between these two portions of the site roughly corresponds to the railroad tracks south of the office/process building (DEQ, 2000).

202017

- The southern PEO site – Diesel- and gasoline-range contamination has been observed in groundwater and soil at depth in the vicinity of the footprint of the former Northwest Oil Co. tank farm.

The key issues relating to contaminant distribution and transport within these portions of the PEO property are presented below.

3.1 Area Primarily Impacted by Time Oil's Bell Terminal Tank Farm (Central PEO Site)

The Conceptual Site Model (CSM) developed to support the remedial investigations identified a number of potential sources for chemicals within the central portion of the PEO site (Bridgewater Group, 2001a). Potential on-site sources of petroleum hydrocarbons include a single 10,000-gal diesel AST formerly located on-site. Installed at two different locations north of the Process Building during the PEO operations at the site (between 1973 and 1996; Figure 2.2), the diesel tank provided a backup fuel supply for the processing plant boilers (which normally operated on natural gas) and had no reported spills (Hanson, 1996). Other potential on-site sources of chemicals include the former north AST farm where crude and processed edible oils were stored, the former wastewater treatment plant, former underground pipelines in the process building or laboratory, and releases from the former Bell Terminal pipeline (Bridgewater Group, 2001a). Note that edible oils are designed for human consumption and for use in food preparation. As such, they not a hazardous substance as defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (DEQ, 2000).

Potential off-site sources identified in the PEO CSM include the neighboring upgradient Time Oil Bell Terminal facility (Bridgewater Group, 2001a; DEQ, 2000). In contrast with the limited petroleum product storage capacity and handling on the PEO site, Time Oil's Bell Terminal was a large, active petroleum product transfer and storage facility consisting of 10 ASTs (ranging in size from 63,000 to 3,360,000 gal each, with a combined storage capacity of more than 12,000,000 gal), a petroleum product loading rack, and an associated above- and below-ground piping network (shown on Figure 3.1). Both gasoline and diesel (as well as other petroleum products) were handled at the Bell Terminal facility, which operated at this location for approximately 50 years, beginning in 1953 (Landau, 2001). Thus, the

DRAFT

petroleum contaminant source potential of the Bell Terminal facility far outweighs that of the PEO property both in the magnitude and diversity of petroleum materials handled and the time period during which such activities occurred.

In addition to incidental or accidental releases or leakage of petroleum products that may have occurred during this half century of operation, review of industry guidance manuals for the time period of the Bell Terminal facility operations indicates substantial potential for releases of petroleum hydrocarbon materials as a result of Time Oil employees following standard industry procedures in managing the petroleum products. In particular, American Petroleum Institute guidance manuals for the first several decades of operation of the Bell Terminal facility reflect the standard industry practices of disposing of sludge from tank cleaning by simply depositing it on the ground surface or, in the case of leaded gasoline, burying it in the ground (e.g., API, 1955a; 1955b; 1968). Reflecting the perspectives of the times, these guidance manuals that were applicable during the first several decades of operation of the Bell Terminal facility emphasize procedures for preventing fires and explosions during tank cleaning, but are generally silent regarding potential environmental contamination posed by the recommended tank cleaning practices. According to sworn testimony from Time Oil employees (e.g., Gallagher, 1998), Time Oil followed the recommended industry practices, which would substantially augment the potential for petroleum hydrocarbon contaminant sources to be present at the upgradient Bell Terminal property. It was not until 1982 that API stopped recommending on-site disposal/burial of tank sludges in its guidance documents (API, 1982).

Contemporaneous publications on waste control and disposal in the petroleum industry confirm that "[l]eaks and spills are practically unavoidable at some locations..." and that sources of oil pollution from oil storage include "free and emulsified oil from leaks, spills, and/or tank drawoff," "tank cleaning wastes," and "tank bottom sludge" (Weston, 1952; p. 460). Relatively large volumes could be released, since "Large complete refineries may be expected to have the equivalent of 0.5 to 3.0 per cent of their crude oil charge escape to the sewers in the form of free oil from leaks, spills, etc." (Weston, 1944; p. 106). These publications' descriptions of waste norms for the petroleum industry are consistent with those described at Time Oil's Northwest Terminal and Bell Terminal by former employees (see, e.g., Brown, 2006). As shown on Figure 3.1, Bell Terminal had a static capacity of 12.7 million gallons. Conservatively assuming that just 0.5% of this static capacity was released during the entire 50 years of

DRAFT

Bell Terminal operations, a minimum of 63,500 gallons of product was likely to have been released to the environment from Time Oil's Bell Terminal operations.

Based on the information available for public review to date, the potential for such sources to exist on the property has not been fully documented or examined in site investigations undertaken by Time Oil. The contrast between the Bell Terminal and PEO facilities with regard to both the amounts and types of petroleum hydrocarbon materials that were handled is also important in light of the observation that concentrations of gasoline-range and diesel-range petroleum hydrocarbons in the groundwater zone "follow a similar distribution pattern" (an observation that is recognized in Time Oil's analyses; see, *e.g.*, p. 7-19 of Time Oil's final Phase III RI report) (Landau, 2005). In particular, the absence of information indicating that gasoline was used to any appreciable extent at the PEO facility undermines the likelihood that sources related to the PEO operations could have generated similar distributions of both diesel-range and gasoline-range petroleum hydrocarbon contaminants.

The following sections present available central PEO site data for surface soils, subsurface soils, groundwater and light non-aqueous phase liquid (LNAPL) from the Focused Site Characterization and RI work (including the Additional Characterization work), together with the current understanding of the sources of contamination as indicated in the available data.

3.1.1 Surface Soil

Review of the surface soil data indicate that the surface soils at the central PEO site are unlikely to present a significant source of contamination to the Willamette River due to the presence of impervious surfaces and runoff controls in many of the areas where chemicals have been reported in surface soils. In addition, total polycyclic aromatic hydrocarbon (PAH) concentrations observed in surface soil samples are within typical and expected urban soil background concentration values.

During the 1998 Focused Site Characterization, approximately 35 surface soil samples (0 – 1 ft bgs) were collected at the central PEO site. Most of these samples were collected from locations beneath asphalt or concrete or within containment areas. These samples were analyzed for TPH (including TPH-gasoline, TPH-diesel, and TPH-heavy oil), oil and grease, volatile organic compounds (VOCs), PAH compounds, and/or chlorinated solvents. The analytical results demonstrated that the surface soil contained

DRAFT

mostly heavy oil-range hydrocarbons, which were composed primarily of edible oils (Bridgewater Group, 1998b; 2001b; AGRA, 2000). Figure 3.2 shows analytical results for TPH compounds and PAHs. These findings are not surprising in light of the purpose for the PEO facility, *i.e.*, an edible oil processing and storage facility. As described above, edible oils are not a hazardous substance as defined by CERCLA (DEQ, 2000).

As illustrated in Figure 3.2, other chemicals detected in surface soils at the central PEO site during the Focused Site Characterization included the following:

- TPH-gasoline was detected at few central PEO site surface soil sample locations evaluated during the Focused Site Characterization (7 out of 19 surface soil samples analyzed for TPH-gasoline), with detected concentrations ranging from 5.9 to 120 mg/kg. All of these locations are beneath impervious surfaces or within containment areas and are not in contact with surface water runoff. As noted above, the PEO facility is unlikely to have served as a substantial source for gasoline hydrocarbons because gasoline was not used or stored in any substantial amounts at the former PEO site (AGRA, 1996).
- PAH compounds were detected in 9 surface soil samples, with total PAH concentrations ranging from 0.07 to 7.28 mg/kg. Possible PAH sources were discussed by Bridgewater Group (1998a) and AGRA (2000) and include the tack coat insulating material under the edible oil tanks, coal tar residues used during historical wartime shipbuilding activities, and emplacement of PAH-containing river-dredge spoils in the mid to late 1930s. It should be noted that the total PAH concentration range detected in site samples is well within typical background levels in urban soils (Bradley *et al.*, 1994; Mauro *et al.*, 2004).¹¹
- TPH-diesel was not detected in any surface soil sample. Only one VOC compound was detected in a single surface soil sample that was collected from beneath an asphalt layer, *i.e.*, trichloroethylene was detected at sampling location SS-6 at a concentration of 13.7 mg/kg. The location of SS-6 is shown on Figure 2.4.

In 1998 and 1999, near-surface soil conditions at the central PEO site were altered during a site preparation and redevelopment effort (Bridgewater Group, 2001a). This effort included removal of ASTs and selected process buildings and structures. In addition, concrete containment sumps and other concrete containment and foundation structures were cleaned, excavated, and crushed. Finally, the north tank farm area of the PEO site was graded so that stormwater was retained and percolated into the ground. The southern tank farm was also graded to retain stormwater.

¹¹ In the work presented by Bradley *et al.* (1994), an average total PAH concentration of 18 mg/kg was observed for 60 surficial soil samples collected from three urban sites in New England. In the survey presented by Mauro *et al.* (2004), surface soil samples were collected from depths of 0 to 6 inches at more than 300 sites in New York, Illinois, and an unspecified western state. Total PAH concentrations ranged from 0.2 to 130 mg/kg, with an average of 10 mg/kg.

202017

During a July 1999 site visit, shallow (1.5 ft bgs) trenching activities targeting the former diesel AST tank locations documented near-surface discolored soils with TPH-diesel concentrations ranging from 98 to 4,280 mg/kg and TPH-gasoline concentrations ranging from 6 to 42 mg/kg (Bridgewater Group, 1999). Visual soil impacts were not observed in near-surface soil trenches located south of the process building. The general areas that encompassed the trench locations were regraded to retain stormwater.

As described in more detail in Gradient (2006b) and discussed in the following section, although localized petroleum releases to surface soil may have occurred on the PEO site (as reflected in the surface soil data), such releases could not account for all (or even a significant portion) of the petroleum product contamination observed in groundwater or soil at depth at the PEO site. In addition, none of the available data (including field observations) for this portion of the site demonstrate a connection between the petroleum contamination observed at depth in this area and any on-site surface sources.

The 2001 RI efforts included collection of 5 surface soil samples (0 - 1 ft bgs), all within runoff-controlled areas (*i.e.*, areas where site features such as grading have been designed to control surface water runoff). Chemical analyses included TPH-gasoline, TPH-diesel, fuel oil #6, VOCs, and PAH compounds. Figure 3.3 presents the RI surface soil results for petroleum hydrocarbon analyses.¹² No TPH-gasoline detections were reported in the north tank farm area of the PEO site.

Overall, the above results show that the detected TPH concentrations and the single observed VOC detection in surface soils at the central PEO site are under paved or impervious layers or within areas graded to retain stormwater, and thus do not contribute to surface soil runoff. Total PAH concentrations are within typical and expected urban soil background concentration values.

3.1.2 Soils at Depth

Review of the soil data collected at depth, including samples from the smear and capillary fringe zones – in conjunction with the surface soil data and information regarding the site operational history –

¹² Multiple results listed for an analyte at a specific location reflect analyses of separate discrete samples collected in the vicinity of that sample location.

strongly point to activities at the upgradient Bell Terminal facility as the primary source of petroleum contamination in the smear zone beneath the downgradient central portion of the PEO site.

Groundwater under the central portion of the PEO site is located at approximately 20 ft bgs with seasonal and tidal fluctuations resulting in an approximately 10 ft thick smear zone of contamination (*i.e.*, a smear zone that extends from approximately 15 to 25 ft bgs). Tidal fluctuation effects extend up to 350 ft inland from the river shoreline, reaching approximately the location of monitoring well MW-06, located south of the former boiler room along the north railroad track (Gradient, 2009). The results of TPH-diesel and TPH-gasoline analyses of soil samples collected at depth in the central portion of the PEO site and on the adjacent, upgradient Time Oil Bell Terminal facility are presented in Figures 3.4 and 3.5, respectively. Sheens and/or odors – and other indications of the presence of elevated petroleum hydrocarbon concentrations – were also documented within the smear zone or at the groundwater level in boring logs for numerous sampling locations within this portion of the PEO site and the Bell Terminal facility. Review of these data yields the following observations:

- As shown in Figure 3.4, elevated TPH-diesel concentrations were observed in smear zone soil samples throughout the western portion of the Bell Terminal property (*e.g.*, 18,000 mg/kg at BLT-56 and 6,200 mg/kg at BT-5) and extend with generally decreasing concentrations downgradient through an area encompassing the sampling locations MW-04, GW-7/SS-7, PB-02 through PB-04, WWP-04, and WWP-05 at the PEO site. As discussed in more detail in Attachment B to Gradient (2006b) and illustrated in Figure 3.6, soil sampling results reported in Time Oil's final Phase III RI report (Landau, 2005) indicate additional locations with elevated TPH-diesel concentrations (*e.g.*, 15,100 mg/kg at sampling location LW-43S, located to the east of sampling location BLT-57), while consideration of the approaches used to report composite sample results suggests a concentration potentially as high as 19,700 mg/kg at sampling location G22-3, located to the east of sampling location BT-01. The representations of contamination in Figure 3.6 result from an integrated evaluation of available soil and groundwater data and observations as described in Gradient (2006b), and denote an area of elevated TPH-diesel throughout a wide area under the Bell Terminal property and extending onto the PEO site. Hypothesized spills or leaks from either of the former locations of the diesel AST on the PEO site could not have resulted in the spatial concentration distribution observed in Figure 3.4, particularly the high TPH-diesel concentrations at locations upgradient and cross-gradient from the former locations of the diesel AST (*i.e.*, the sample locations with PB-, BLT-, and WWP- prefixes). Instead, the pattern of high TPH-diesel concentrations detected at and downgradient from the Bell Terminal facility points to Bell Terminal as the more plausible source of these elevated concentrations.
- As shown in Figure 3.5, TPH-gasoline concentrations in soil samples collected at depth at the Bell Terminal facility and in the central portion of the PEO site were more variable. Additional sampling results reported in Time Oil's final Phase III RI report (Landau, 2005)

for TPH-gasoline in smear zone soils are discussed in Attachment B to Gradient (2006b) and are presented in Figure 3.7. The representations of contamination in Figure 3.7 result from an integrated evaluation of available soil and groundwater data and observations as described in Gradient (2006b), and denote an area of elevated TPH-gasoline throughout a wide area under the Bell Terminal property and extending onto the PEO site. Because there are no known substantial uses or storage of gasoline on the central PEO property (AGRA, 1996; Bridgewater Group, 2001a), the most plausible gasoline source is again the neighboring Bell Terminal property – where substantial amounts of gasoline were handled and where Time Oil employees acknowledged following standard historic industry practices for cleaning gasoline storage tanks, including recommendations for disposing of petroleum hydrocarbon-containing tank bottoms and sludges directly onto the ground surface or into the ground (Gallagher, 1998). Although the connection between the upgradient Bell Terminal facility and the TPH-gasoline contamination observed on the downgradient PEO site is not reflected in a concentration gradient that is as consistent as that observed in the TPH-diesel concentrations displayed in Figure 3.4, the more erratic TPH-gasoline concentration distribution likely reflects commonly observed variations in TPH-gasoline concentrations in soil that arise due to soil sample collection techniques. While approved sampling methods were used to collect these soil samples, the soil sample collection process typically disturbs the soil matrix and can release variable amounts of volatile components. As a result, the observed concentrations of TPH-gasoline in soil can be highly variable and can be less applicable for rigorous quantitative evaluations of the distribution of TPH-gasoline in soil. Moreover, as discussed in Gradient (2004), questions regarding the degree to which certain soil samples collected by Time Oil at the Bell Terminal facility are representative of actual conditions in the smear zone must also be considered when interpreting the available data.

Considering the surface and smear zone soil data as a whole indicates that chemicals detected in the surface soils of the PEO site are unlikely to have contributed significantly, if at all, to the chemical concentrations observed in the smear zone soils and groundwater at the central PEO site.

First, as discussed above, gasoline- and diesel-range petroleum hydrocarbons were either not detected, or detected in only limited amounts in surface soil samples. Although higher concentrations of heavy-range hydrocarbons were reported in surface soil samples, these concentrations were attributed primarily to edible oils, not petroleum hydrocarbons.

Second, a review of site information indicates that a number of measures were historically in place that limited vertical contaminant migration during the former PEO and C&T Quincy Foods site activities. These measures included the following:

DRAFT

- Impervious areas of asphalt or concrete covered approximately 75% of the site (Hanson, 1996).
- A 1-inch to 3-inch-thick insulating "tack coat" layer was added to compacted sand beneath ASTs prior to their construction. This type of layer is expected to reduce the permeability of the sand layer below ASTs, and thus to reduce the potential for infiltration.

Some contaminants (including TPH-gasoline, TPH-diesel, and TPH-heavy oil) were reported in soils below the impervious soil cover, presumably as the result of migration through cracks in the cover materials. These protective barriers, however, would have served to reduce the potential for vertical migration of contaminants from inadvertent spills and leaks. Note that the 1998 to 1999 site preparation and redevelopment efforts modified site surface conditions to their current state as described in Section 2.1.1.

Finally, field data support the lack of significant vertical contaminant migration from site surface soils. In particular, during the 2001 RI and the 2008 Additional Characterization field work, visual observations of contamination, sheen tests, and photoionization detector readings did not indicate any substantial presence of elevated TPH in soil at intermediate depths (*i.e.*, between 1 and 15 ft bgs; Bridgewater Group, 2001b; Gradient, 2009). Thus, these investigations found no evidence of a significant connection between the surface soils and smear zone soil contamination.

Therefore, the evidence provided by the soil data collected in surface samples and at depth (in combination with information regarding the site operational history) strongly point to activities at the Bell Terminal facility as the primary source of petroleum contamination in the smear zone beneath the downgradient central portion of the PEO site.

3.1.3 Groundwater

At the central PEO site, groundwater flows from the upgradient Bell Terminal facility southwest towards the PEO site (Figures 2.11 and 2.12), further supporting the role of Bell Terminal as a source of petroleum hydrocarbon contamination at the PEO site. TPH-diesel and TPH-gasoline results for groundwater at the former PEO site and upgradient areas on the Bell Terminal facility are presented in Figure 3.8. Note that Figure 3.8 includes recent groundwater sampling results from monitoring wells, but also includes historic well-point-based groundwater sampling results from geoprobe investigations. The well-point results may not be reflective of current conditions and are subject to the limitations of well-point

DRAFT

sampling, including the potential for particulate matter to be incorporated into such samples potentially resulting in analytical results that do not accurately reflect dissolved chemical concentrations in groundwater. Note that Figure 3.8 and the discussion in this section include PEO site results from the recent coordinated sampling event with Time Oil. Time Oil Bell Terminal groundwater sampling results will be reviewed and assessed when they are available.

As discussed in Section 1.2.4 of Attachment A of Gradient (2006b), care must be used in interpreting the results of TPH analyses for groundwater, particularly when evaluating groundwater quality within a quantitative framework based on such data. In particular, the high TPH-gasoline and TPH-diesel concentrations observed in many of the groundwater samples indicate that product or petroleum-contaminated soil was incorporated into the collected groundwater samples. Similar to the findings based on petroleum hydrocarbon presence in smear zone soils, however, the TPH results for groundwater samples displayed in Figure 3.8 demonstrate the presence of elevated levels of petroleum hydrocarbon compounds in groundwater samples throughout a broad area encompassing the central and western portions of the upgradient Bell Terminal facility and extending downgradient to a broad range of locations on the PEO site. As noted previously, gasoline detections in groundwater are unlikely to be attributable to former activities on the central PEO site, since there are no known substantial gasoline sources at the central PEO site. By contrast, known sources of substantial amounts of gasoline existed at the upgradient Bell Terminal facility. Moreover, terminal operations that were conducted consistent with recommended petroleum industry storage tank farm management guidelines would have resulted in the placement of petroleum hydrocarbon-containing tank bottoms and sludges directly on and within the tank farm soils.

Additional evidence for the likely relationship between the contamination originating on the Bell Terminal and that observed at the PEO property is provided by gas chromatography/flame ionization detector TPH chromatograms. These chromatograms show consistency among the diesel-range components, suggesting that TPH-diesel can be attributed to a common source. Figure 3.10 depicts the chromatograms for samples collected from the following selected sampling locations for which chromatograms were available: BT-04; LW-32; BT-03; BT-05; LW-30S; SCH-61; SCH-62; MW-04; and GW-04. The diesel-range materials can be observed in the center of each chromatogram, and appear consistent with each other. The chromatographic data indicate an area of diesel contamination that begins, at a minimum, at the center of the Bell Terminal property and extends downgradient to the west and

southwest, affecting a large area under the former PEO property. Additional information regarding this chromatographic analysis is presented in Gradient (2004).

3.1.4 LNAPL

When evaluating the implications of LNAPL observations at petroleum sites, it is important to consider recognized critical factors influencing interpretation of such data. In particular, reviews by US EPA and others regarding both theoretical factors and empirical data associated with LNAPL measurements have observed that LNAPL thickness measurements can vary widely depending on the measurement technique used and various features of monitoring well construction and design (e.g., Massachusetts LSPA, 2005). Moreover, although a number of predictive approaches have been developed to estimate the "true" LNAPL thickness based on LNAPL measurements in the field, "the predictability of these methods indicates an order of magnitude accuracy of the predicted *versus* the measured free product thickness among the methods" (US EPA, 1996, as cited in Massachusetts LSPA, 2005). Thus, just as groundwater data for TPH and its constituents must be evaluated within the context of various field sampling and analytical factors that may influence observed analytical results (as discussed in Section 1.2.4 of Gradient, 2006b), LNAPL data also must be interpreted within the context of a comparable suite of influential factors.

During groundwater monitoring events conducted at the former PEO property, LNAPL was observed intermittently in the central portion of the PEO property at monitoring well MW-04, with apparent thicknesses ranging from zero to as much as 6 ft, with recent observations of only zero or trace amounts of LNAPL (Figure 3.9). Monitoring well MW-04 is located upgradient from the former locations of the PEO diesel AST and hypothetical releases from either of those locations could not account for the amount of product historically observed at MW-04.¹³ It is also noteworthy that no product was observed in sampling conducted at monitoring well locations MW-05 and MW-20, which are located downgradient of the former locations of the PEO diesel AST, which also supports the low likelihood of substantial releases from the PEO diesel AST. In addition, site chemistry data indicate the substantial presence of both gasoline- and diesel-range petroleum hydrocarbon constituents at and near the location of MW-4; however,

¹³ For example, as discussed in more detail in Gradient (2004), even if one considers an unrealistic hypothetical scenario that assumes that diesel released from one of the former locations of the AST would have spread upgradient in sufficient quantities to generate the impacts observed at monitoring well MW-04, such a scenario would require a release equivalent to more than 5 times the total diesel AST storage capacity at the PEO site (i.e., more than 50,000 gallons of diesel) to generate the apparent LNAPL thickness observed at MW-04.

DRAFT

only diesel fuel was stored in the PEO petroleum AST. For example, analyses of gas chromatogram information from groundwater sample collected at this location indicate the presence of both weathered diesel and weathered gasoline (Bridgewater Group, 1998b). Similarly, chemical analyses of a product sample collected from MW-4 reported a TPH-gasoline concentration of 291,000 mg/kg and a TPH-diesel concentration of 787,000 mg/kg (Bridgewater Group, 2001b). Petroleum product handling and storage activities occurring upgradient from the locations of the diesel AST – and involving handling of both diesel fuel and gasoline (such as historically occurred at the upgradient Bell Terminal facility) – are a more plausible source of the product observed at MW-04.

No LNAPL has been observed in monitoring wells located downgradient from MW-04, *e.g.*, MW-05 or MW-20. Estimating that mobile LNAPL travels at a velocity between 14 and 290 ft/yr (as calculated for the southern PEO site in Appendix B), mobile LNAPL would be expected to have already appeared at both MW-20 and MW-05. Since LNAPL has not been detected at either of these wells, it is likely that the LNAPL historically observed at MW-4 is now immobilized as residual.

3.1.5 Sediment

Surface and subsurface sediment samples collected adjacent to the central PEO site have TPH and PAH concentrations that are generally less than the averages for the corresponding intervals from the entire Portland Harbor Study Area. As reported in LWG (2004a; 2007; 2008), a total of 9 sediment samples have been collected adjacent to the central PEO site at a total of 5 locations; samples from multiple depths were collected from two of these locations. Samples collected within 100 ft of the central PEO site shoreline and dock were the primary focus of this sediment analysis; however, data from other samples collected further offshore from the site were also reviewed. Sediment surface grab samples SD007 (0 to 0.3 ft depth and 0 to 3 ft depths) and SD008 (0 to 0.3 ft depth) were collected by US EPA in 1997 and analyzed for conventionals, grainsize, metals, PAHs, phenols, phthalates, and SVOCs. Surface grab samples G065 (0 to 1 ft depth) and G068 (0 to 0.9 ft depth) were collected by LWG's consultants in 2004 and analyzed for conventionals, grainsize, metals, PAHs, PCBs (Aroclors), pesticides, phenols, phthalates, and SVOCs. Co-located surface grab samples G067 (0 to 0.8 ft depth) and sediment core samples C067 (0 to 0.8 ft, 1 to 5 ft, 9 to 13 ft, and 13 to 16 ft depths) were collected by LWG's consultants in 2004 and analyzed for conventionals, dioxins (C067 only), grainsize, metals, PAHs, PCBs (Aroclors, congeners

[G067 only], homologs [G067 only]), pesticides, petroleum, phenols, phthalates, semivolatile organic compounds (SVOCs), and VOCs.

Table 3.1 summarizes the concentrations of petroleum hydrocarbon-related chemicals in the samples located within 100 ft of the central PEO site shoreline and dock, while Figure 3.11 shows results for all sample locations and concentrations within the Willamette River offshore of the PEO site, including samples that are further offshore. Detected concentrations of total PAH compounds in sediments adjacent to the central PEO site are less than the 20 mg/kg threshold for urban background reported in Stout *et al.* (2004), but are generally greater than total PAH concentrations found in surface soils on the PEO site. As reported in LWG (2007), average detected total PAH concentrations in the Portland Harbor are 33.2 mg/kg in surface sediments (98.5% detection frequency in 1,329 samples) and 213 mg/kg in subsurface sediments (95.6% detection frequency in 1,090 samples). Based on these averages, sediments adjacent to the PEO site have relatively low concentrations of total PAH compounds compared to the rest of the Portland Harbor Study Area. Similarly, concentrations of TPH constituents are less than the threshold for urban background of 415 mg/kg for total extractable hydrocarbons reported in Stout *et al.* (2004). LWG (2007) reports average detected TPH concentrations of 1,180 mg/kg (97% detection frequency in 443 samples) in surface sediments and 2,700 mg/kg (84% detection frequency in 718 samples) in subsurface sediments within the Portland Harbor study areas. Concentrations of petroleum hydrocarbon-related constituents in sediments further offshore from the central PEO site are generally less than Portland Harbor Study Area averages as well.

Table 3.1
Summary of TPH and Total PAH Concentration Data in Central PEO-Area
Sediment Samples from LWG Field Sampling Program and Reports (mg/kg)

Depth Range ^a	SD007	SD008	G065	G067/ C067	G068
0 - 1 ft	P - 0.8	P - 9	P - 1.7	G - 1.9 U D - 77 J R - 330 J P - 1.5	P - 1.5
1 - 5 ft	P - 12			G - 1.8 U D - 120 J R - 320 J P - 2.0	
3 - 9 ft					
9 - 13 ft				G - 19 J D - 640 J R - 880 J P - 16	
13 - 16 ft				G - 19 J D - 350 J R - 560 J P - 4.6	

Notes:

- G TPH-gasoline range
- D TPH-diesel range
- R TPH-residual range
- P Total PAHs
- U Non-detect, value given is method reporting limit
- J Estimated value
- (a) Specific depth ranges vary by sample. The summary information provided in this table reflects the total range represented by all samples within a given depth category.

Sediment samples adjacent to Outfall 1 were collected at 0.5 ft and 1 ft depths during May, 2001. These sample locations and petroleum hydrocarbon-related results are shown in Figure 3.11 and are tabulated in Table 3.2. Both depth intervals of sample HA-OT-1-39 and the shallow interval from Outfall-01 are less than the average total PAH concentration for urban background reported in Stout *et al.* (2004). The deeper sample from Outfall-01 has a higher concentration of total PAHs (96 mg/kg), but is still well below the corresponding average of 213 mg/kg reported by LWG (2007) for subsurface sediments in the Portland Harbor Study Area. TPH concentrations from Outfall-01 are similar to average values for the Portland Harbor Study Area, but higher than urban background concentrations reported by Stout *et al.* (2004), while TPH concentrations from HA-OT-1-39 are comparable or lower than urban background and lower than Portland Harbor Study Area averages. As discussed in detail in Gradient (2006b), the

DRAFT

distribution of PAH compounds observed in the outfall samples suggests a pyrogenic source (e.g. from typical urban sources such as vehicle emissions) rather than a petrogenic source (such as diesel fuel or gasoline).

Table 3.2
Summary of TPH and Total PAH Concentration Data in Central PEO-Area
Sediment Samples Near Outfall 1 (mg/kg)

Depth Interval	Outfall-01	HA-OT-1-39
0 - 1 ft	G - 3.3 J	G - 4 U
	D - 2200 J	D - 250 U
	R - 2060 J	R - 487 D
	P - 17	P - 8.6
0 - 2 ft	G - 4 U	G - 4 U
	D - 250 U	D - 25 U
	R - 1290 D	R - 116
	P - 96	P - 3.0

Notes:

G *TPH-gasoline range*
D *TPH-diesel range*
R *TPH-residual range*
P *Total PAHs*
U *Non-detect, value given is method reporting limit*
J *Estimated value*

3.2 Area Primarily Impacted by Former Northwest Oil Co. Tank Farm (Southern PEO Site)

At the southern PEO site, the former Northwest Oil Co. tank farm is the sole potential on-site source of substantial amounts of petroleum hydrocarbons identified in the PEO CSM (Bridgewater Group, 2001a). This finding is supported by the substantial data collected in this area of the site as well as the site operational history. Additional potential sources of chemicals identified in the PEO CSM include the warehouse, concrete pad, blending building, south edible oils tank farm used by PEO, and storage buildings used by Oregon Shipbuilding (Bridgewater Group, 2001a).

From 1941 to 1943, Northwest Oil Co.¹⁴ owned and operated an aboveground petroleum storage facility on the southern portion of the PEO site which included 7 vertical ASTs and several horizontal ASTs (Bridgewater Group, 2000a; 2000b) – with the capacity to store approximately 3 million gal of petroleum products – as well as a loading dock (Brown, 2008). In late 1943, Northwest Oil Co. moved this tank farm to its current location as the initial facilities at the Time Oil Northwest Terminal north of the PEO site (Bridgewater Group, 2000a; 2000b). Additional information regarding this facility is discussed in Section 2.3 of Attachment A to Gradient (2006b). Currently, a concrete pad covers much of the former tank farm footprint on the PEO site.

The former Northwest Oil Co. tank farm was the sole activity in the southern portion of the PEO site that involved handling or storage of substantial amounts of petroleum hydrocarbons. In addition, all observed petroleum hydrocarbon impacts in this portion of the site are consistent with the historical footprint of the facility and its associated loading dock. As a result, this former tank farm is the most plausible source of the subsurface contamination in this portion of the site. DEQ has also recognized the likely contributions of the former tank farm in its Environmental Cleanup Site Information (ECSI) database summary for the PEO site, which concludes that the petroleum hydrocarbon contamination in this portion of the site "appears to be from historic site operations (DEQ, 2009b)."

The following sections present available southern PEO site data for surface soils, subsurface soils, groundwater, and LNAPL from the Focused Site Characterization, RI, and Additional Characterization work, together with the current understanding of the sources of contamination as inferred from the available data.

3.2.1 Surface Soil

Review of the surface soil data indicate that the surface soils in the southern PEO site are unlikely to present a significant source of contamination to the Willamette River due to the generally low concentrations of petroleum hydrocarbons reported in surface soil samples as well the presence of runoff controls.

¹⁴ Available information indicates that the Northwest Oil Company was a predecessor company to Time Oil (e.g., TOC Holdings Co., 2008; LWG, 2004b).

202017

DRAFT

During the 1998 Focused Site Characterization, 11 surface soil samples (0 to 1 ft bgs) were collected and analyzed at the southern PEO site. These samples were analyzed for TPH-gasoline, TPH-diesel, TPH-heavy oil, oil and grease, VOCs, PAH compounds, and/or chlorinated solvents. The analytical results demonstrated that the surface soil contained primarily heavy oil-range hydrocarbons, whose composition was typical of coal tar or tack coat (Bridgewater Group, 1998b; 2001b; AGRA, 2000). Figure 3.2 shows analytical results for TPH compounds and PAHs, where analyzed. As illustrated in Figure 3.2, other chemicals detected in surface soils at the southern PEO site during the Focused Site Characterization included the following:

- TPH-gasoline was detected at few southern PEO site surface soil sample locations evaluated during the Focused Site Characterization (*i.e.*, 3 out of 7 surface soil samples analyzed for TPH-gasoline), with detected concentrations of 9.68, 10.5, and 4,380 mg/kg. The single high detection, SS-24 (4,380 mg/kg), was collected beneath an impermeable surface (which has since been removed) and is now within a runoff-controlled area. This sample most likely reflects historical impacts from the former Northwest Oil Co., given its location under impermeable surfaces and proximate location to the former petroleum product tank farm. It is also noteworthy that the TPH-gasoline concentration reported in a subsequent soil sample collected approximately 3 years later in a nearby location was more than 3 orders of magnitude less than the concentration reported for sampling location SS-24 (*i.e.*, 2.56 mg/kg collected from a depth of 1 ft bgs at location STF-16, shown on Figure 3.3). No substantial field observations indicative of the presence of elevated TPH (*e.g.*, staining, odors, and elevated PID readings) were reported at this sampling location until a depth of 12 ft bgs was reached. These findings suggest that the elevated TPH-gasoline concentration reported for surface soil at SS-24 was not indicative of wide-spread conditions in this portion of the site, or of a significant surface source at this location. Outside of the runoff-controlled areas, TPH-gasoline was detected at low concentrations in two samples collected around the concrete pad in the southern portion of the site and within the area of the former Northwest Oil Co. tank farm (*i.e.*, 9.7 mg/kg in sample SS-90 and 10.5 mg/kg in sample SS-91). As noted above, the PEO facility is unlikely to have served as a substantial source for gasoline hydrocarbons because there is no record of gasoline usage and there was no tank storage for gasoline at the former PEO site (AGRA, 1996). Moreover, the localized and low TPH-gasoline concentrations observed in surface soil samples from the southern portion of the site are generally within or in close proximity to the former Northwest Oil Co. tank farm and are subject to runoff controls. These data indicate that the former PEO site does not contribute significantly to any contaminated runoff to the Willamette River.
- PAH compounds were detected in 5 surface soil samples, with total PAH concentrations ranging from 1.2 to 10.06 mg/kg. Possible PAH sources were discussed by Bridgewater Group (1998a) and AGRA (2000) and include the tack coat insulating material under the edible oil tanks, historical coal tar residues used during wartime shipbuilding activities, and depositing of river-dredge spoils containing coal tar residues in the mid to late 1930s. The total PAH concentration range detected in site samples is well within typical background levels in urban soils (Bradley *et al.*, 1994; Mauro *et al.*, 2004).¹⁵
- TPH-diesel and VOCs were not detected in any surface soil sample from the southern PEO site.

As described in Section 3.1.1, during 1998 and 1999, near-surface soil conditions at the PEO site were altered during a site preparation and redevelopment effort (Bridgewater Group, 2001a). Activities in

¹⁵ In the work presented by Bradley *et al.* (1994), an average total PAH concentration of 18 mg/kg was observed for 60 surficial soil samples collected from three urban sites in New England. In the survey presented by Mauro *et al.* (2004), surface soil samples were collected from depths of 0 to 6 inches at more than 300 sites in New York, Illinois, and a western state. Total PAH concentrations ranged from 0.2 to 130 mg/kg, with an average of 10 mg/kg.

DRAFT

the southern PEO site included the removal of the south tank farm storage tanks and other structures and the removal of concrete containment and foundation structures. The southern tank farm was also graded to retain stormwater.

The 2001 RI efforts included the collection of one surface soil sample (STF-16, 0 - 1 ft bgs), within the footprint of the former Northwest Oil Co. tank farm facility and in the vicinity of the crushed concrete pile from the 1999 activities (Figure 3.3). In this area, overland runoff is directed away from the river. Chemical analyses included TPH-gasoline, TPH-diesel, fuel oil #6, VOCs, and PAH compounds. Diesel, gasoline, and fuel oil #6 were detected in this sample. No VOCs were detected in this sample. The gasoline detection at this location (2.6 mg/kg) was substantially less than the result observed in the proximate sample SS-24 (4,380 mg/kg) during the sampling that occurred in this area prior to the site redevelopment efforts.

Overall, available data indicate that surface soil concentrations of diesel and gasoline in the Southern PEO site are generally low. A single higher detection of gasoline is located in a runoff-controlled area. Concentrations of heavy oil-range hydrocarbons are highest within and near the former Northwest Oil Co. tank farm footprint and likely associated with coal tar or tack coat residuals. Samples with high heavy oil detections also tend to have detections of PAH compounds, although these detections are well within expected urban background levels in soils as discussed above.

3.2.2 Soils at Depth

Soil data collected at depth – including from the smear zone and capillary fringe zone – strongly point to the former Northwest Oil Co. tank farm as the primary and most likely sole contributor to petroleum hydrocarbon contamination in the smear zone soils beneath the southern portion of the PEO site.

Soil under the southern portion of the PEO site is fine- to medium-grained sand with thin layers/lenses of silt and clay. The water table is tidally and seasonally influenced, resulting in a smear zone of contamination of approximately 10 ft, similar to the central PEO site. The water table is located at approximately 16 to 25 ft bgs. Groundwater generally flows toward the Willamette River but is subject to seasonal flow reversals (Figures 2.11 and 2.12). Tidal fluctuation effects extend up to 350 ft inland from the river shoreline, reaching approximately the location of monitoring well MW-06, located south of the

former boiler room along the north railroad track (Gradient, 2009). This area of tidal fluctuation encompasses most of the southern PEO site.

The results of TPH-diesel and TPH-gasoline analyses of soil samples collected at depth in the southern portion of the PEO site are presented in Figures 3.4 and 3.5, respectively. Sheens and/or odors were also documented within the smear zone or at the groundwater level in boring logs for numerous sampling locations within this portion of the PEO site. Review of these data yields the following observations:

- As shown in Figure 3.4, elevated TPH-diesel concentrations were observed in smear zone soil samples within and to the south and west of the former Northwest Oil Co. Tank Farm footprint. Low or non-detect TPH-diesel concentrations are found to the north and to the east of the former tank farm. This pattern of TPH-diesel concentrations points to the former Northwest Oil Co. tank farm as the source of petroleum hydrocarbon-related contamination in this area.
- As shown in Figure 3.5, TPH-gasoline concentrations in soil samples collected at depth at the southern PEO site follow a similar pattern to TPH-diesel observations, *i.e.*, elevated concentrations in the former Northwest Oil Co. tank farm and in downgradient areas. There were no known substantial uses or storage of gasoline at the PEO facility (AGRA, 1996; Bridgewater Group, 2001a). Thus, based on the distribution of contamination, the only plausible identified gasoline source is the former Northwest Oil Co. tank farm.

Although surface soil concentrations of diesel and gasoline are generally low or non-detect in the southern PEO site, qualitative indications of petroleum hydrocarbon-related impacts were observed in soil boring PB-9 – within the footprint of the Northwest Oil Co. tank farm – from the near-surface soils down through the smear zone, as detailed in Gradient (2009). This observation indicates the presence of a near-surface source in the former Northwest Oil Co. tank farm footprint, consistent with a tank release(s). Furthermore, soils samples collected at similar depth to the smear zone at locations up- and cross-gradient from the former Northwest Oil Co. tank farm footprint do not demonstrate any evidence of petroleum hydrocarbon contamination. Thus, the smear and capillary fringe zone soil data strongly point to the former Northwest Oil Co. tank farm as the primary source of petroleum hydrocarbon contamination in the smear zone soils beneath the southern portion of the PEO site. Heavy oils are generally undetectable in smear and capillary fringe zone soils, indicating that these materials are confined to surface materials and not vertically mobile.

3.2.3 Groundwater

Similarly to the soil data collected at smear zone depth, groundwater data in the southern portion of the PEO site also support the conclusion that the former Northwest Oil Co. tank farm is the primary and most likely sole contributor to petroleum hydrocarbon contamination found beneath this portion of the PEO site.

At the southern PEO site, the direction of groundwater flow is to the southwest, with seasonal reversals directing flow to the northeast (Figures 2.11 and 2.12). TPH-diesel and TPH-gasoline results for groundwater at the former PEO site and upgradient areas on the Bell Terminal facility are presented in Figure 3.8. Note that Figure 3.8 includes recent groundwater sampling results from monitoring wells, but also historic well-point-based groundwater sampling results from geoprobe investigations. The well-point results may not be reflective of current conditions and are subject to the limitations of well-point sampling, including the potential for particulate matter to be incorporated into such samples potentially resulting in analytical results that do not accurately reflect dissolved chemical concentrations in groundwater. As discussed in Section 3.1.3 above, care must be used in interpreting the results of TPH analyses for groundwater, particularly when evaluating groundwater quality within a quantitative framework based on such data.

Similar to the findings in smear zone soils, the TPH results for groundwater samples displayed in Figure 3.8 demonstrate the presence of elevated levels of petroleum hydrocarbon compounds in groundwater samples within and downgradient from the former Northwest Oil Co. tank farm. TPH detections at MW-19, MW-6, and MW-3¹⁶ could be the result of transport of contaminants from the Bell Terminal source area.¹⁷ These observations are also likely to reflect the variability of TPH measurements for groundwater discussed above, or may result from seasonal flow reversals transporting contaminants from the Northwest Oil Co. tank farm source.

¹⁶ Note that although TPH compounds were not detected in groundwater samples from MW-19 and MW-3 during the February 2009 sampling event (as reflected in Figure 3.8), TPH-diesel has been detected in groundwater from these wells periodically, as detailed in Gradient (2009). During the 2008-2009 sampling events, MW-3 had a single detection of TPH-diesel in January 2009 while MW-19 had detections of TPH-diesel in June, August, and November 2008.

¹⁷ Based on the inferred direction of groundwater flow from Bell Terminal toward these wells (see Figure 2.11) as well as the presence of upgradient TPH contamination at Bell Terminal (see Figure 3.8).

202017

3.2.4 LNAPL

Although site investigations have observed LNAPL in monitoring wells near the Willamette River, available data provide no evidence that the site presents a source of LNAPL transport to the river.

The investigative efforts in the southern portion of the site reported LNAPL at several monitoring wells with variable thickness affected by tidal fluctuations. These variable thicknesses included observations of zero LNAPL thickness in at least one sampling event for each well in which product was observed in this portion of the PEO site. Critical factors for interpreting apparent LNAPL thickness data are discussed in Section 3.1.4. The maximum apparent LNAPL thickness in this portion of the site (4.01 ft) was observed at monitoring well MW-2, located downgradient of the former Northwest Oil Co. tank farm (Figure 3.9).¹⁸ Analysis of a product sample collected from MW-02 showed gasoline-range (416,000 mg/kg) and diesel-range (627,000 mg/kg) petroleum hydrocarbons (Bridgewater Group, 2001b). As noted above, TPH analyses of groundwater samples also reported gasoline- and diesel-range petroleum hydrocarbon concentrations in a variety of locations in the vicinity of the former Northwest Oil Co. tank farm location (Figure 3.8).

In light of the proximity of the observed LNAPL to the Willamette River, 23 riverbank surveys were conducted from September 2001 to December 2003 to look for any sheen, seeps, or oil at the riverbank. The surveys reported no observed contamination (Gradient, 2009).

Numerous observations of apparent LNAPL thickness in monitoring wells in the southern PEO site have been collected since 2001. From 2001 - 2003, apparent LNAPL thickness measurements were taken on an approximately monthly basis, and these measurements showed both spatial and temporal variability, with all wells having instances of zero LNAPL thickness (Figure 3.9). In 2008, two 48-hr LNAPL thickness surveys were completed and several individual LNAPL thickness measurements were collected at the southern PEO site as detailed in Gradient (2009). During the February 2008 survey, LNAPL was observed in most wells for the duration of the survey, with the apparent thickness correlating strongly with the Willamette River stage. Conversely, during the November 2008 survey most wells showed only trace or zero amounts of LNAPL for the entire 48 hrs. Only MW-02 and MW-11 (two downgradient wells in

¹⁸ Apparent thickness is the measured LNAPL thickness in a monitoring well. This thickness is exaggerated by the tidal effects, and is much larger than the true NAPL thickness in the aquifer formation (Kemblowski and Cheng, 1988, Hunt *et al.*, 1989).

202017

DRAFT

closest proximity to the footprint of the former Northwest Oil Co. tank farm) showed apparent LNAPL thickness greater than 1 inch during the November 2008 survey. Notably, groundwater flow direction was reversed from its typical southwesterly direction during the November 2008 survey. Individual measurements taken during 2008 - 2009 were consistent with those taken during 2001 - 2003, both in terms of the thickness of LNAPL when observed, and the occasional observation of zero product thickness in all wells.

Taken as a whole, the collection of observations at the southern PEO site indicates that seasonal and tidal water table fluctuations and periodic flow reversals prevent the transport of LNAPL to the Willamette River. Results of the November 2008 survey and the 2001 - 2009 individual observations indicate that, for the majority of the time, LNAPL at the southwestern portion of the site is trapped as residual hydrocarbons within the aquifer formation. Observations from the February 2008 survey and selected results from 2001 - 2003 indicate that seasonal and tidal conditions can combine to free some of the LNAPL from residual, resulting in measurable amounts in monitoring wells. Riverbank surveys confirm that LNAPL is not seeping into the Willamette River. However, the residual and occasionally free-phase LNAPL at the southern PEO site represents an ongoing source of dissolved petroleum hydrocarbon components to groundwater.

3.2.5 Sediment

Surface and subsurface sediment samples collected adjacent to the southern PEO site have TPH and PAH concentrations that are generally less than the averages for the corresponding intervals from the entire Portland Harbor Study Area.

As reported in LWG (2003; 2004a; 2007; 2008), a total of 17 sediment samples have been collected adjacent to the southern PEO site at a total of seven locations; samples from multiple depths were collected from three of these locations. Similar to the evaluations for the central PEO site, samples collected within 100 ft of the southern PEO site shoreline, the former Northwest Oil Company dock, and Outfall 3 were the primary focus of this sediment analysis; however, data from other samples collected further offshore from the site were also reviewed. Sediment surface grab samples SD009 (0 - 0.3 ft depth) and SD010 (0 - 0.3 ft) were collected by US EPA in 1997 and analyzed for conventional parameters, grainsize, metals, PAHs, phenols, phthalates, and SVOCs. Surface grab sample 03R034 (0-0.5 ft depth)

DRAFT

was collected by LWG's consultants in 2003 and analyzed for conventional parameters, metals, PAHs, PCBs (Aroclors), pesticides, herbicides, and SVOCs. Surface grab sample G071 (0 - 0.9 ft depth) was collected by LWG's consultants in 2004 and analyzed for conventional parameters, grainsize, metals, PAHs, PCBs (Aroclors), pesticides, phenols, phthalates, and SVOCs. Co-located surface grab samples and sediment core samples G073/C073 (0 - 0.9 ft, 1 - 3 ft, 3 - 7 ft, 7 - 10 ft), G074/C074 (0 - 0.9 ft, 1 - 3 ft, 3 - 7 ft, 7 - 11 ft, 13-15 ft), and G078/C078 (0 - 1 ft, 1 - 5 ft, 5 - 9 ft, 9 - 12 ft) were collected by LWG's consultants in 2004 and 2005 and analyzed for butyltins (G078/C078 only) conventional parameters, grainsize, metals, PAHs, PCBs (Aroclors), pesticides, petroleum, phenols, phthalates, SVOCs, and VOCs. Table 3.3 summarizes the concentrations of petroleum hydrocarbon-related chemicals in samples adjacent to the southern PEO site, while Figure 3.11 shows results for all sample locations and concentrations within the Willamette River offshore of the PEO site, including those samples that are further offshore.

Detected concentrations of total PAH compounds in sediments adjacent to the southern PEO site are generally well below the 20 mg/kg threshold for urban background reported in Stout *et al.* (2004), with the exception of one result of 20 mg/kg observed in a sample collected at depth from sampling location C073, near the location of the former Northwest Oil Co. loading dock. As reported in LWG (2007), average detected total PAH concentrations in Portland Harbor are 33.2 mg/kg in surface sediments (with a 98.5% detection frequency in 1,329 samples) and 213 mg/kg in subsurface sediments (with a 95.6% detection frequency in 1,090 samples). Based on these averages, sediments adjacent to the southern PEO site have relatively low concentrations of total PAH compounds compared to the rest of the Portland Harbor Study Area. Concentrations of petroleum hydrocarbon-related constituents in sediments from samples collected further offshore of the southern PEO site are generally lower than Portland Harbor Study Area averages as well.

Similarly, concentrations of TPH constituents are generally well below the threshold for urban background of 415 mg/kg for total extractable hydrocarbons reported in Stout *et al.* (2004). For samples collected within the Portland Harbor study areas, LWG (2007) reports average detected TPH concentrations of 1,180 mg/kg in surface sediments (with a 97% detection frequency in 443 samples) and 2,700 mg/kg in subsurface sediments (with a 84% detection frequency in 718 samples). Surface and subsurface sediments adjacent to the southern PEO site have generally lower TPH concentrations than the averages for corresponding intervals within the Portland Harbor Study Area.

Table 3.3
Summary of TPH and Total PAH Concentration Data in Southern PEO-Area
Sediment Samples from LWG Field Sampling Program and Reports (mg/kg)

Depth Range ^a	SD009	SD010	G071	G073/ C073	G074/ C074	03R034	G078/ C078
0 - 1 ft	P - 1.9	P - 0.45	P - 0.63	G - 1.5 U D - 15 U R - 28 U P - 0.08	G - 1.4 UT D - 10 JT R - 25 UT P - 0.055	P - 0.068	G - 3.9 JT D - 8.0 J R - 34 J P - 0.057
1 - 5 ft				G - 1.4 UT D - 17 JT R - 57 JT P - 0.28	G - 1.7 U D - 38 J R - 160 J P - 0.26		G - 1.5 U D - 4.9 U R - 14 J P - 0.0011
3 - 9 ft				G - 5.0 UT D - 130 J R - 250 J P - 2.7	G - 1.9 UT D - 19 J R - 45 U P - 0.14		G - 5.8 J D - 4.9 U R - 12 J P - 0.0013
9 - 13 ft				G - 6.4 U D - 285 JT R - 460 JT P - 20	G - 2.2 U D - 22 J R - 63 J P - 0.23		G - 4.1 J
13 - 16 ft					G - 1.4 UT D - 13 UT R - 8.4 UT P - 0.00088		

Notes:

- G: TPH-gasoline range
D: TPH-diesel range
R: TPH-residual range
P: Total PAH
U: Non-detect, value given is method reporting limit
J: Estimated value
T: Average or selected value (from LWG database)
(a): Specific depth ranges vary by sample. The summary information provided in this table reflects the total range represented by all samples within a given depth category.

Sediment samples adjacent to Outfall 2 were collected at 0.5 ft and 1 ft depths during May 2001. These sample locations and petroleum hydrocarbon-related results are shown in Figure 3.11 and tabulated in Table 3.4, below. Both depth intervals of samples from Outfall-02 and HA-OT-1-39 are less than the average TPH and total PAH concentrations for urban background reported in Stout *et al.* (2004). The results for these samples are also well below the averages for these compounds reported in LWG (2007) for the Portland Harbor Study Area. As discussed in detail in Gradient (2006b), the distribution of PAH

DRAFT

compounds observed in the outfall samples suggests a pyrogenic source (e.g., from typical urban sources such as vehicle emissions) rather than a petrogenic source (such as diesel fuel or gasoline).

Table 3.4
Summary of TPH and Total PAH Concentration Data in Central PEO-Area
Sediment Samples near Outfall 2 (mg/kg)

Depth Interval	Outfall-02	HA-OT-2-37
0 - 1 ft	G - 4 U	G - 4 U
	D - 190 J	D - 40
	R - 493 D	R - 146
	P - 3.4	P - 4.3
0 - 2 ft	G - 4 U	G - 4 U
	D - 25 U	D - 25 U
	R - 40 J	R - 29 J
	P - 2.4	P - 0.1

Notes:

G: *TPH-gasoline range*
D: *TPH-diesel range*
R: *TPH-residual range*
P: *Total PAH*

4 Potential Migration Pathways

This section reviews potential migration pathways by which contamination at the PEO site could reach the Willamette River. The pathway evaluation is organized to correspond with the potential migration pathways reported in DEQ's Portland Harbor milestone reports (e.g., Table 1 of DEQ, 2009c), and addresses all of the pathways identified as of interest in the JSCS documentation (DEQ and US EPA, 2005), including groundwater, LNAPL transport, overland transport, bank erosion, stormwater, overwater activities, and other pathways. As appropriate, pathways are either discussed separately for the southern and central portions of the PEO site, or are discussed for the site as a whole. This section evaluates whether completion of these pathways is physically possible, while Section 5 uses SLVs specified in the JSCS documentation to evaluate whether detected concentrations of contaminants in potentially complete pathways are at levels of potential concern.

Based on the analyses presented in this section, the groundwater transport pathway for dissolved chemicals has been identified as potentially complete for this site. Although the stormwater transport pathway is also likely to be currently complete for a small portion of the site, this pathway is an insignificant source of contaminants to the Willamette River, based on site conditions and previous DEQ evaluations of this potential discharge pathway. All other potential transport pathways for this site have been determined to be incomplete. The basis for these conclusions is presented below.

4.1 Groundwater

Groundwater at the PEO site generally travels towards and discharges to the Willamette River. In accordance with the JSCS criteria, the groundwater pathway is considered potentially complete if dissolved contaminants are present at the point of groundwater discharge to the Willamette River.

4.1.1 Area Primarily Impacted by Time Oil's Bell Terminal Tank Farm (Central PEO Site)

As discussed in Section 3.1.3, site data indicates the presence of dissolved petroleum hydrocarbon contamination in shallow groundwater extending from the central portion of the adjacent Bell Terminal tank farm into the central PEO site. This shallow groundwater contamination has the potential to migrate to and discharge into the Willamette River. Accordingly, contaminant concentrations in groundwater observed in

monitoring wells closest to the Willamette River and downgradient from the groundwater contamination area originating at the Bell Terminal (MW-7 and MW-19) are evaluated against JSCS SLVs in Section 5.

4.1.2 Area Primarily Impacted by Former Northwest Oil Co. Tank Farm (Southern PEO Site)

Subsurface LNAPL observed within and downgradient of the footprint of the former Northwest Oil Co. Tank Farm – as described in Section 3.2.4 – serves as an ongoing source of dissolved petroleum hydrocarbons in the southern portion of the PEO site which potentially reaches the Willamette River. Contaminant concentrations in groundwater in wells closest to the Willamette River – including wells downgradient of the former Northwest Oil Co. tank farm – are therefore compared against JSCS SLVs in Section 5.

4.2 LNAPL Transport

As described in Section 3, LNAPL has been observed in both the central and southern portions of the PEO site. This section discusses the potential for this LNAPL to migrate to the Willamette River.

4.2.1 Area Primarily Impacted by Time Oil's Bell Terminal Tank Farm (Central PEO Site)

In the central PEO site, LNAPL has been observed only in monitoring well MW-4, with recent observations of only trace amounts of product (Gradient, 2009). Since there are multiple wells with recent observations of zero LNAPL observed approximately downgradient between MW-4 and the Willamette River (*i.e.*, MW-20, MW-5, MW-19, and MW-7), the LNAPL transport pathway to the river is incomplete for the central PEO site.

4.2.2 Area Primarily Impacted by Former Northwest Oil Co. Tank Farm (Southern PEO Site)

Measurable thicknesses of LNAPL have been observed in multiple wells in the southern PEO site. Interior wells (including MW-2 and MW-11) most consistently contain measurable LNAPL, while wells closer to the Willamette River do not contain LNAPL for the majority of historical observations (*e.g.*, MW-9, MW-12, and MW-13). Observations of apparent LNAPL thicknesses fluctuate widely with seasonal and tidal water table fluctuations, which appear to create a tidal buffer zone. Site-specific

DRAFT

parameters and a conservative calculation of hypothetical travel time indicate that transport of LNAPL from the former Northwest Oil Co. tank farm area would take between 1 and 20 years. Travel time calculations are detailed in Appendix B. Since the release(s) from the Northwest Oil Co. tanks likely occurred between 1941 and 1943, there has been more than sufficient time for LNAPL transport from the tanks to the river. However, LNAPL discharges to the Willamette River or banks at the PEO site were neither observed in a series of shoreline surveys undertaken in 2001 through 2003, nor in a recent DEQ site visit (DEQ, 2009b). These findings indicate that the LNAPL has been trapped as residual hydrocarbons within the aquifer formation at the site for many years. The LNAPL transport pathway is therefore currently incomplete, and unlikely to be complete in the future given the substantial amount of time that the LNAPL has been in place at its current location. However, the LNAPL serves as a source of dissolved chemicals to groundwater.

4.3 Overland Transport/Sheet Flow

Since the PEO site is vacant, the only potential sources of contaminants to overland transport or sheet flow are surficial contamination or "on-flow" from adjacent sites. Figure 4.1 shows site impermeable areas, drainage patterns, and surface soil sampling results.

The PEO site is topographically flat (with the exception of the river banks; see Section 4.4), and where exposed, site surface soils do not exhibit signs of erosional transport such as channeling. On-site erosional controls include impermeable surfaces and extensive grassy vegetation. Areas where petroleum hydrocarbon-related constituents have been detected in surface soil samples are generally within runoff-controlled areas. In these runoff-controlled areas (shown as areas of infiltration in Figure 4.1), stormwater is collected and then infiltrates through the permeable surface soil. Generally, surface soil conditions within these areas on the PEO site are favorable for infiltration. As detailed in Section 2.1.2, near-surface soils include silty gravels (fill) and sand and silt deposits (alluvium). Conservatively assuming that the vertical conductivity of these soils is about 10% of the low end estimate of site horizontal hydraulic conductivity of 10 ft/day, runoff-controlled areas of the site have the capacity to absorb at least 12 inches of precipitation per day. This compares favorably with the maximum recorded 24-hr rainfall of 10.6 inches in 1950. In the southwest area of the former Northwest Oil Co. tank farm, surface soil with historical detections of TPH constituents exists in areas with limited potential for runoff to the river. However, soils in this area of the site are stabilized with grassy vegetation and do not experience significant

erosion. Overall, overland transport and sheet flow is not currently a complete pathway for materials from the PEO site to the Willamette River.

The possibility exists for the materials from the adjacent Jefferson Smurfit and Time Oil Bell Terminal sites to enter the PEO site *via* sheet flow. Evaluation of on-flow from these sites is beyond the scope of this SCE, but should be considered as components of the Source Control Evaluations for each of these two sites. Given the flat and relatively permeable nature of the PEO site, it is unlikely that runoff from these adjacent sites would reach the Willamette River through the PEO site.

4.4 Bank Erosion

The banks surrounding the PEO site are largely composed of nonerodible material. Appendix A contains a detailed photo log of the PEO site bank, while Figure 4.2 delineates the bank materials, including portions of the bank that may be susceptible to erosion. The top of the bank is stabilized with vegetation, while the majority of the slope of the bank is stabilized with both vegetation and rip-rap. Generally, the potentially erodible portion of the bank incorporates a mid-bank steep strip of soil approximately two to four feet in height extending along the southwest bank into the mouth of the International Terminals slip. In elevation, the erodible bank materials are well above the smear zone and water table, and so would not be impacted by transport of contaminated groundwater or subsurface LNAPL. Furthermore, no visual evidence of contamination, such as staining or seeps, has ever been observed along the bank, and sediments adjacent to the site in these areas have low or non-detect concentrations of TPH constituents and total PAHs. Overall, it is unlikely that erosion of the bank is a significant source of contaminated materials to the Willamette River.

4.5 Stormwater

Similar to overland transport/sheet flow, the only potential sources of contaminants to the PEO site stormwater system are surficial contamination, groundwater infiltration, or on-flow from adjacent sites. Stormwater lines and site drainage patterns are shown in Figure 4.1. Outfalls 1, 2 and CB-3 are capped and do not discharge to the Willamette River and catch basin CB-17 is covered at the surface to prevent entry of stormwater.

The area within and to the east of the concrete pad drains to the stormwater system which eventually discharges to Outfall 3 in the International Terminals slip. The Outfall 3 system also drains portions of the Jefferson Smurfit site. Surface soil data are limited in this portion of the PEO site; however, the limited nature of the historical operations in this portion of the site reduce the likelihood of surface contamination in this area. DEQ's conclusions regarding the SCE efforts being undertaken at the sites within the Portland Harbor Superfund site are presented in periodic Milestone Reports. The most recent Portland Harbor Milestone Report issued by DEQ indicates that stormwater evaluations (including Outfall 3) for the Jefferson Smurfit site are complete, that stormwater is an insignificant pathway for the site and requires no source control measures, and that the priority for the stormwater pathway is low (DEQ, 2009c). Outfall 3 is permitted by Jefferson Smurfit under an NPDES 1200-Z general permit (file number 109845) and stormwater samples collected pursuant to this permit have generally been in compliance except for isolated deficiencies in Oil and Grease in 1998 and 2002 and Total Suspended Solids in 2001 and 2005 (Smurfit-Stone, 2008). Groundwater infiltration into the PEO stormwater system is unlikely given that stormwater structures are likely many feet above the water table which is generally 15 to 25 ft bgs. Furthermore, active on-site stormwater conveyances are located in an area of the site without observed groundwater contamination. Given the low or non-detect concentrations of petroleum-related contaminants in sediment adjacent to Outfall 3 (*e.g.*, sample location C078, shown on Figure 3.11), the evaluation already completed at Jefferson Smurfit, and the lack of contaminant sources in the portion of the PEO site drained by Outfall 3, the stormwater pathway for the PEO site represents an insignificant pathway for contaminant transport. Based on available information regarding runoff controls at the PEO site (*e.g.*, closure of outfalls to the Willamette River), DEQ assigned a pathway priority of "none" to the stormwater pathway in the PEO site listing provided in the most recent DEQ Milestone Report (DEQ, 2009c).

In summary, most of the PEO stormwater conveyances are physically blocked to prevent discharge and the existing stormwater evaluation of the only remaining outfall – Outfall 3, which discharges to the International Terminals slip – indicates that stormwater from this outfall is an insignificant transport pathway for contaminants to the Willamette River. Moreover, low or non-detect concentrations of petroleum-related contaminants have been observed in sediment samples collected adjacent to Outfall 3. As a result, available information provides no evidence of any significant link between the PEO site contaminants and Portland Harbor sediments through the stormwater pathway. Therefore, in accordance with the criteria outlined in Section 2 of the DEQ Guidance for Evaluating the Stormwater Pathway at

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Upland Sites (DEQ, 2009d), the site does not present any of the conditions meriting a formal stormwater evaluation.

4.6 Overwater Activities

There are currently no overwater activities associated with the vacant PEO site, therefore the overwater activities pathway is incomplete. In accordance with this fact, DEQ assigned a pathway priority of "none" to the overwater activities pathway in the PEO site listing provided in the most recent DEQ Milestone Report (DEQ, 2009c).

4.7 Other

No other pathways of contamination transport from the PEO site to the Willamette River have been identified.

5 Site Data Screening Using JSCS Screening Level Values

As described in the preceding section, the groundwater transport pathway was the only potentially significant and complete migration pathway to the river identified for the PEO site. Accordingly, in this section, groundwater concentrations of contaminants are compared against the proposed Portland Harbor JSCS screening level values. As described in the JSCS, SLVs were developed to conservatively identify potential threats to human health and the environment, and are not cleanup levels. Cleanup levels will be defined in the US EPA's Portland Harbor administrative Record(s) of Decision. The SLVs used in this evaluation are compiled from the most current version of JSCS Table 3-1 (*i.e.*, the 7/16/07 Revision). This version of Table 3-1 highlights the SLVs for initial upland source control screening, which are the values used in this assessment. As specified in the JSCS, these SLVs are used without consideration of their applicability to the specific conditions and characteristics of Portland Harbor or the PEO site.

As acknowledged by DEQ and US EPA, the initial screening levels specified in the JSCS are conservative and designed to identify and prioritize sites and contaminants potentially impacting the Willamette River (*e.g.*, DEQ and US EPA, 2005). For example, the SLV prescribed for groundwater for many of the noncarcinogenic PAH compounds (such as acenaphthene, fluoranthene, fluorene, and pyrene) is a US EPA maximum contaminant level (MCL) for drinking water of 0.2 µg/L. This MCL was derived for benzo(a)pyrene, which is a carcinogenic compound. This SLV greatly overestimates the risk for noncarcinogenic PAHs, which do not themselves have chemical-specific MCLs assigned by the US EPA. Moreover, the use of a drinking water standard as a screen for potential risks associated with groundwater discharges from the PEO site is highly conservative, as such use of site groundwater is not an applicable beneficial use for this site. The JSCS SLV screening process adds another conservative element by not allowing for the inclusion of dilution factor adjustments to the SLVs. At the PEO site, the closest practical monitoring locations to the river are roughly 60 ft from the typical shoreline due to the steep banks surrounding the site. Concentrations in groundwater observed in these wells are attenuated in transport to the river, and are further significantly attenuated upon discharge and mixing with the Willamette River.

SLV comparisons are performed for groundwater in the southern and central PEO site as the sole potentially complete migration pathway for this site. The comparisons are based primarily on recently collected (2008 - 2009) groundwater data as most reflective of current site conditions. All constituents that have been detected at the site – and for which the JSCS documentation provides an SLV – are included in

the SLV analyses. All individual groundwater concentration measurements collected during 2008-2009 from all monitoring wells are compared against SLVs; the complete results of this comparison are included in Appendix C. However, to evaluate the potential for constituents to reach the Willamette River at concentrations that are greater than the JSCS SLVs, only those wells closest to the river have been considered.

Consistent with the CSM, which associates petroleum hydrocarbons with the primary operations on the PEO site and vicinity, this SLV comparison also focuses on petroleum hydrocarbon-related contaminants for which the JSCS documentation presents SLVs, such as PAH compounds and BTEX (benzene, toluene, ethylbenzene, and xylenes). Although extensively used for site characterization, TPH parameters are not included in the SLV evaluation because the JSCS documentation does not include SLVs for TPH and communications with the DEQ Project Manager have affirmed that the SLV evaluation for petroleum hydrocarbons should be based on consideration of individual potentially toxic constituents. As a preliminary screening, metals concentrations are compared against SLVs when detected. However, a more complete weight-of-evidence evaluation of metals data will be completed when site-specific background levels and risk-based values for these chemicals are established through the RI/FS and Risk Assessment processes – enabling the weight-of-evidence approach outlined in the JSCS documentation.

5.1 Groundwater in the Area Primarily Impacted by Time Oil's Bell Terminal (Central PEO Site)

Summarized results of SLV screening for the PEO site are shown on Figures 5.1 through 5.3, while detailed SLV comparison results are tabulated in Appendix C. Central PEO site area wells that are farther from the river and closer to the Bell Terminal facility – including MW-04, MW-05, MW-06, and MW-20 – have some groundwater concentrations that are greater than JSCS SLVs for BTEX, PAH compounds, and metals. Downgradient well MW-19 has only an isolated sampling event in which the concentration of a single chemical (benzene) in groundwater was approximately twice the JSCS SLV of 1.2 µg/L. Concentrations of manganese in this well were also greater than the JSCS SLV; however, manganese is a nearly ubiquitous and likely background component of PEO site groundwater. In addition, the SLV for this compound is based on a secondary drinking water standard (*i.e.*, a standard based on prevention of cosmetic or aesthetic effects [*e.g.*, taste or odor] associated with chemicals in drinking water supplies, not on any adverse health or ecological effects). Moreover, as discussed in Section 2.4, use of

PEO site groundwater as a drinking water supply is not an applicable beneficial use for this site due to low aquifer yields and the availability of alternative supplies. The furthest downgradient well in this area (MW-7) does not have any detected groundwater concentrations that are greater than the JSCS SLVs. Considering the limited SLV exceedances at MW-19 and the lack of SLV exceedances at MW-7, chemicals that are present in central PEO site groundwater are not currently reaching the Willamette River at concentrations that are greater than the JSCS SLVs.

5.2 Groundwater in the Area Primarily Impacted by the Former Northwest Oil Co. Tank Farm (Southern PEO Site) Groundwater

The intermittent presence of measurable product in many of the wells in the vicinity of the former Northwest Oil Co. tank farm often precludes collecting groundwater samples from these wells. During the January 2009 sampling event, most of these wells did not contain product and could be sampled. The concentrations from this event, and concentrations from surrounding wells that have not historically contained product were used in the SLV evaluation. Figures 5.1 through 5.3 summarize the results of the SLV comparisons.

Wells closest to the river including MW-18, MW-12, MW-09, MW-13, and MW-23 have concentrations of certain PAH compounds in groundwater that are consistently greater than the JSCS SLVs (*i.e.*, acenaphthene, fluorene, and phenanthrene). The concentrations of these compounds are a factor of 3 to 11 greater than the JSCS SLVs. As noted above, however, the SLV for these noncarcinogenic PAH compounds is based on a drinking water value established for benzo[a]pyrene, a carcinogenic chemical. If screening concentrations were established to more accurately reflect available toxicological information for these noncarcinogenic chemicals, they would likely be substantially greater than the drinking water standard set based on benzo[a]pyrene. Deep well MW-10 has a single concentration of acenaphthene that is only slightly greater than the JSCS SLV (*i.e.*, the ratio of the groundwater concentration and the JSCS SLV is 1.2). None of the PAH concentrations measured in groundwater samples from monitoring well MW-24 are greater than the JSCS SLVs. Thus, this well delineates the southeastern edge of PAH concentrations that are greater than the SLVs.

Groundwater concentrations for BTEX compounds that are greater than the JSCS SLVs are somewhat more narrowly distributed than concentrations of PAH compounds that are greater than the

DRAFT

SLVs. Near-river wells MW-12, MW-09, MW-13, and MW-23 have groundwater concentrations for BTEX compounds that are greater than the JSCS SLVs. By contrast, groundwater concentrations of BTEX compounds in monitoring wells MW-08, MW-18, and MW-24 are not greater than any JSCS SLVs and thus delineate the northern, northwestern, and southeastern limits of BTEX concentrations that are greater than the JSCS SLVs, respectively.

Groundwater concentrations of manganese in all wells in the southern PEO site are greater than the JSCS SLV for manganese. Given the fairly uniform distribution of this compound in groundwater throughout the site, manganese concentrations are likely reflective of background conditions rather than of any site-specific contributions. In addition, as noted in Section 5.1, the JSCS SLV is a secondary drinking water standard based on prevention of aesthetic impacts, not adverse health or ecological effects. As further noted in Section 5.1, use of PEO site groundwater as a drinking water supply is not an applicable beneficial use for this site due to low aquifer yields and the availability of alternative supplies. For monitoring wells MW-18 and MW-23, a single measurement of the arsenic concentration in each well is greater than the JSCS SLV; however, the specified JSCS SLV is a US EPA Region 9 screening value that is based on generic risk assessment assumptions regarding consumption of tap water, a groundwater use that is not an applicable beneficial use at this site. Moreover, the generic Region 9 risk-based value is more than 200-fold less than the formal drinking water standard (*i.e.*, the MCL) that the US EPA has established for arsenic. The risk and remediation implications of reported metals concentrations in groundwater at the PEO site will be further evaluated when site-specific background levels and risk-based concentrations are established during the RI/FS and Risk Assessment evaluations.

The only instance in which a measured groundwater concentration for any other chemical was greater than its associated SLV was observed in a November 22, 2008 groundwater sample from MW-18. In this sample, trichloroethene (TCE) was detected at a concentration of 1.5 µg/L, which is greater than the associated SLV of 0.17 µg/L (which the JSCS documentation specifies is based on a US EPA Region 9 Tap Water Preliminary Remediation Goal). TCE was not detected in the 3 prior samples and 1 subsequent sample from MW-18. In addition, the single detected concentration of TCE at MW-18 is less than the US EPA MCL of 5 µg/L, and TCE was not detected elsewhere on the PEO site in any of the 2008 - 2009 sampling events. In light of these facts, this single detection does not warrant further investigation of TCE or indicate that the PEO site is serving as a source of this chemical to the Willamette River.

Given the potential for groundwater transport of PAH and BTEX compounds to the Willamette River, the potential amount and impact of this groundwater discharge to the Willamette River was evaluated using conservative assumptions. This calculation assumed a contaminant discharge zone of 20 ft in height (*i.e.*, the approximate distance from the water table to the deep zone) and 500 ft in width (*i.e.*, the approximate shoreline distance from monitoring wells MW-18 to MW-24), and a discharge velocity of 5 ft/day (*i.e.*, the high end of estimates discussed in Section 2.1). Based on these values, an upper-bound estimate of groundwater discharge is 1,400,000 L/day. Reflecting average shoreline concentrations (*i.e.*, the mean of individual well mean concentrations for each compound from 2008-2009 samples), Table 5.1 shows potential concentrations in the Willamette River that would result from discharge from the PEO site, using a historically low flow rate of 4,200 cfs as reported by the US Geological Survey for discharge station 14211720 for July 10, 1978 (USGS, 2009). Overall, the potential river concentrations estimated for the site discharge are approximately 3 to 4 orders of magnitude less than the JSCS-specified initial SLVs. Although the JSCS process does not allow for the consideration of dilution processes, these calculations demonstrate the magnitude of potential dilution, and the low likelihood of actual harm to river receptors associated with the measured groundwater concentrations.

Table 5.1
Conservative Estimates of Mass Discharge of BTEX and PAHs in Groundwater to the Willamette River

Parameter	JSCS Highlighted SLV (µg/L)	Average Shoreline Concentration (µg/L)	Conservative Resulting In-river Concentration (µg/L)
<i>BTEX</i>			
Benzene	1.2	42	0.0058
Ethylbenzene	7.3	8	0.0011
Toluene	9.8	20	0.0028
o-Xylene	13	5	0.00071
m,p-Xylene	1.8	28	0.0038
<i>PAHs</i>			
Acenaphthene	0.2	1.4	0.00020
Fluoranthene	0.2	0.17	0.000024
Fluorene	0.2	2.3	0.00031
Phenanthrene	0.2	1.4	0.00019

6 Conclusions / Recommendations

As outlined in the JSCS, this SCE has identified and described sources of contaminants on the PEO site, evaluated potential pathways for those contaminants to reach the Willamette River, and compared contaminant concentrations to JSCS-specified SLVs for pathways deemed potentially complete. The pathway-specific findings for potential transport of contamination at the PEO site to the Willamette River are summarized in Table 6.1, as well as below, together with recommendations for additional action, if applicable.

6.1 Groundwater

6.1.1 Area Primarily Impacted by Time Oil's Bell Terminal (Central PEO Site)

Based on comparisons of site data with JSCS SLVs, petroleum hydrocarbon-related contaminants from the area of the PEO site primarily impacted by Time Oil's Bell Terminal are not currently reaching the Willamette River at concentrations that are greater than the SLVs. Recommended actions for this part of the site include periodic groundwater monitoring, while the recommended priority for this pathway is low. It is also recommended that metals concentrations in groundwater be re-evaluated when site-specific background concentrations and risk-based evaluations are developed.

6.1.2 Area Primarily Impacted by the Former Northwest Oil Co. Tank Farm (Southern PEO Site)

Comparisons of groundwater measurements in this portion of the site with the JSCS SLVs reveal the potential for BTEX and PAH components to discharge to the Willamette River, albeit at levels that reflect a low likelihood of actual risks to receptors in the river. Recommended actions for this part of the site include additional weight-of-evidence analyses of the groundwater concentrations using more applicable and site-specific risk assessment considerations and, if appropriate, evaluation of potential SCMs in combination with the assessment of LNAPL in this part of the site. It is recommended that both of these additional categories of analysis be undertaken in conjunction with the ongoing RI/FS and Risk Assessment evaluations. In accordance with the JSCS priority definitions, a medium priority is recommended for this pathway, reflecting the need for further evaluation of available data and the limited likelihood of actual harm associated with concentrations measured at the site.

6.2 LNAPL

6.2.1 Area Primarily Impacted by Time Oil's Bell Terminal (Central PEO Site)

Recent monitoring at the central PEO site has not detected LNAPL, and historic monitoring has consistently found a number of wells without product between the product measured at MW-4 and the Willamette River. Thus, LNAPL in the central portion of the PEO site – which is primarily caused by migration from Time Oil's Bell Terminal – is not reaching the Willamette River. Recommended actions for this central portion of the site include periodic monitoring of wells for evidence of measurable product.

6.2.2 Area Primarily Impacted by the Former Northwest Oil Co. Tank Farm (Southern PEO Site)

Recent and historical investigations in the southwestern part of the site reveal an area of fluctuating measurable LNAPL thicknesses, subject to the containing effects of seasonal and tidal water table variations. LNAPL thickness in wells ranges from zero to approximately 4 ft of product. Sheens, staining, or other visual indications of LNAPL discharge to the river have not been observed during numerous site inspections, over many years. Given the fact the LNAPL was likely released in the early 1940s and hypothetical travel times for LNAPL from the former Northwest Oil Co. tank farm to the Willamette River range from 1 - 20 years, the LNAPL's continued presence in this portion of the site suggests that the LNAPL has been trapped in place in "quasi"-steady state for many years. None of the substantial data collected in this portion of the site indicate that LNAPL is currently being transported to the river; however, it is recommended that – in conjunction with the RI/FS and Risk Assessment analyses – SCMs for LNAPL be evaluated to remove it as a source of dissolved contaminants to groundwater. Based on the JSCS priority definitions, it is recommended that this pathway be given a medium priority, reflecting the need for further evaluation of available data and the limited likelihood of actual harm associated with concentrations measured at the site. Although the LNAPL serves as a source of dissolved contaminants, the recommended priority reflects the relatively low potential groundwater contaminant discharge rates to the Willamette River discussed above, and the low likelihood that these discharges would result in actual harm.

6.3 Overland Transport/Sheet Flow

Site topography and stabilizing vegetation combine to make erosional runoff on the PEO site unlikely. Most areas of the site with historical detections of petroleum-related contaminants in surface soils are graded to prevent runoff. The southwestern portion of the site has limited potential for soil erosion and transport. Ongoing evaluations of runoff patterns at the site will be supplemented this fall during a major storm event. These observations will be incorporated into the RI/FS evaluations. It is recommended that this pathway be given a low priority based on its limited potential to contribute contaminants to the Willamette River, and the relatively low degree of petroleum hydrocarbon-related sediment contamination adjacent to the PEO site.

6.4 Bank Erosion

The majority of PEO site banks are stabilized with rip-rap and/or vegetation. The potentially erodible section of the bank is unlikely to contain contaminants based on its location away from observed site contamination and activities, lack of visual indications of contamination, and relatively low degree of petroleum hydrocarbon-related contamination in adjacent Willamette River sediments. No further action and a low priority are recommended for the bank erosion pathway.

6.5 Stormwater

Stormwater conveyances formerly draining areas of significant site operations have been capped to prevent discharge in 1998. Remaining functional stormwater conveyances drain an area of limited historical site operations, and discharge to an NPDES permitted outfall, which has been addressed in stormwater evaluations undertaken for the adjacent Jefferson Smurfit site. Stormwater monitoring of this outfall has demonstrated NPDES-permit compliance, and concentrations of petroleum-related contaminants in sediments adjacent to the outfall discharge are relatively low. In addition, the most recent publicly available Portland Harbor Milestone Report indicates that stormwater evaluations for the Jefferson Smurfit site are complete, that stormwater is an insignificant pathway for the site, and that the priority for stormwater is low (DEQ, 2009c). Recommended actions for the stormwater pathway include the establishment of institutional controls to require stormwater monitoring if site outfalls are reopened or site operations change. Currently there are no operations at the site. As discussed above, it is unlikely that

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stormwater from the PEO site is transporting site contaminants to the Willamette River and the stormwater evaluations at the Jefferson Smurfit site – which included PEO site drainage – are considered complete by DEQ. As a result, the recommended priority for this pathway is none, consistent with DEQ's current designation of this pathway in its most recent Milestone Report (DEQ, 2009c).

6.6 Overwater Activities

There are currently no overwater activities at the vacant PEO site. It is recommended that institutional controls be established to require evaluation of potential overwater impacts from any potential future site operations if they include an overwater component. The recommended priority for this pathway is none, consistent with DEQ's current designation of this pathway in its most recent Milestone Report (DEQ, 2009c).

6.7 Other

No other potential transport pathways have been identified for the PEO site.

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Tables

Table 6.1
Source Control Evaluation Summary

Potential Contaminant Migration Pathway	Site Area	Pathway Determination ¹	Recommended Priority	Recommended Further Actions	Rationale
Groundwater -- Dissolved contaminants	Central PEO Site	Incomplete	Low	Periodic monitoring	-Concentrations below SLVs in near shore wells
	Southern PEO Site	Potentially Complete	Medium	Re-evaluate post-completion of LNAPL SCM evaluation	-Concentrations above SLVs in near shore wells -Need to address LNAPL source first
Groundwater -- LNAPL	Central PEO Site	Incomplete	Low	Periodic monitoring	-LNAPL delimited to interior of site
	Southern PEO Site	Incomplete	Medium	Evaluate SCMs	-LNAPL held in place by tidal buffer zone but is source of TPH components to groundwater
Overland Transport/Sheet Flow	Entire PEO Site	Incomplete	Low	Confirm runoff patterns	-Presence of erosional controls including grading and vegetation
Bank Erosion	Entire PEO Site	Incomplete	Low	None	-Predominantly erosion-controlled banks -Erodible areas removed from contamination -Sediment samples proximate to erodible materials do not show impacts
Stormwater	Entire PEO Site	Incomplete	None	Institutional controls for stormwater closures	-Most stormwater conveyances dismantled -Active conveyances drain un-impacted portion of site, are permitted, and were evaluated in the Jefferson Smurfit SCE -Sediment sampling near active outfall does not show impacts
Overwater Activities	Entire PEO Site	Incomplete	None	None	-No overwater activities on site
Other	Entire PEO Site	Incomplete	None	None	-No other pathways identified

¹This column indicates whether the pathway has been determined to be a complete transport pathway as a source of site contaminants to reach the Willamette River.

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Figures

202017

Draft.SCE.Report_PEO.Site_061109_202017.doc

Gradient CORPORATION

PEO Site

PORTLAND

PORTLAND

Saint Johns



Gradient CORPORATION

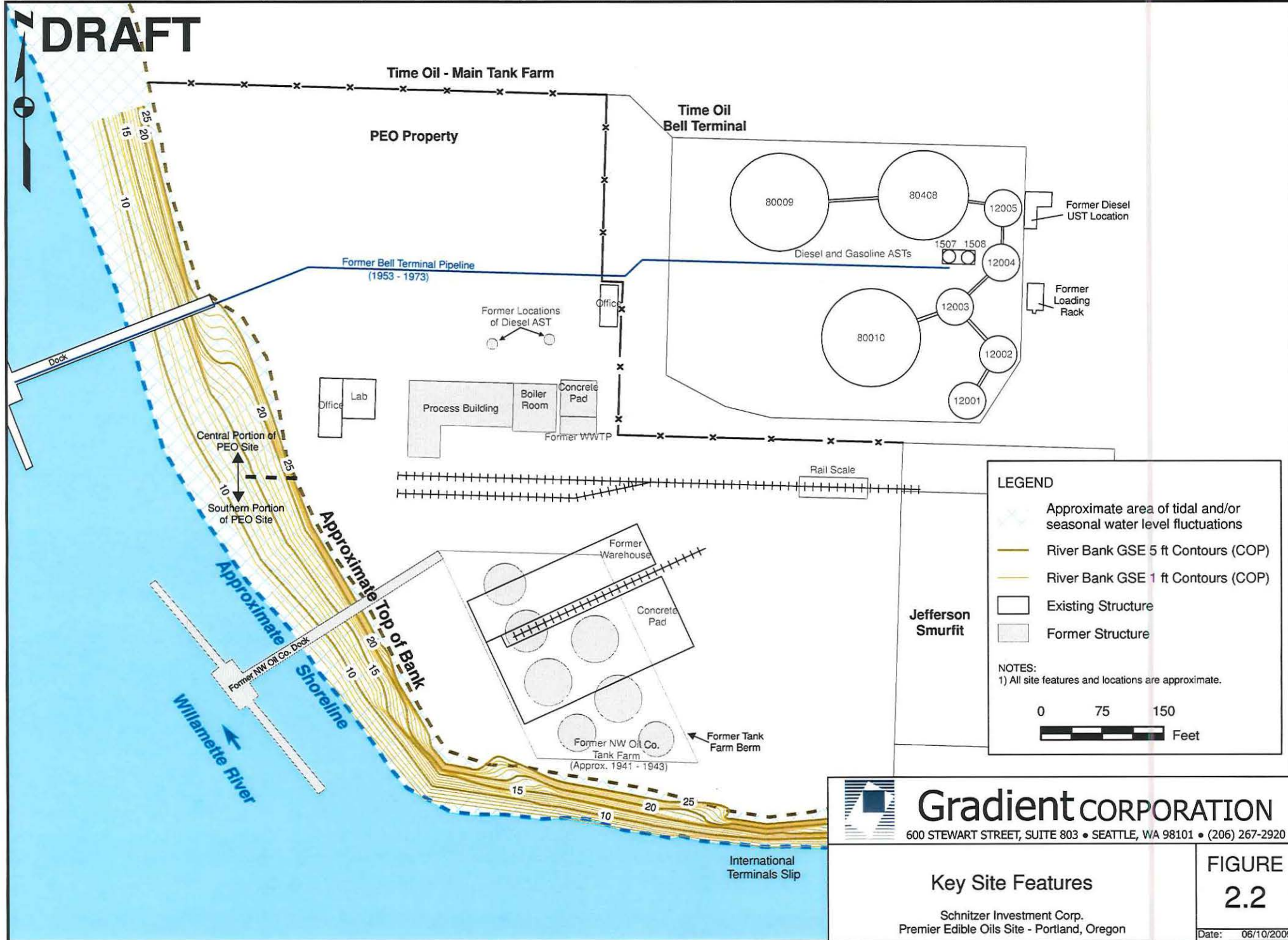
600 STEWART STREET, SUITE 803 • SEATTLE, WA 98101 • (206) 267-2920

PEO Site Location Map

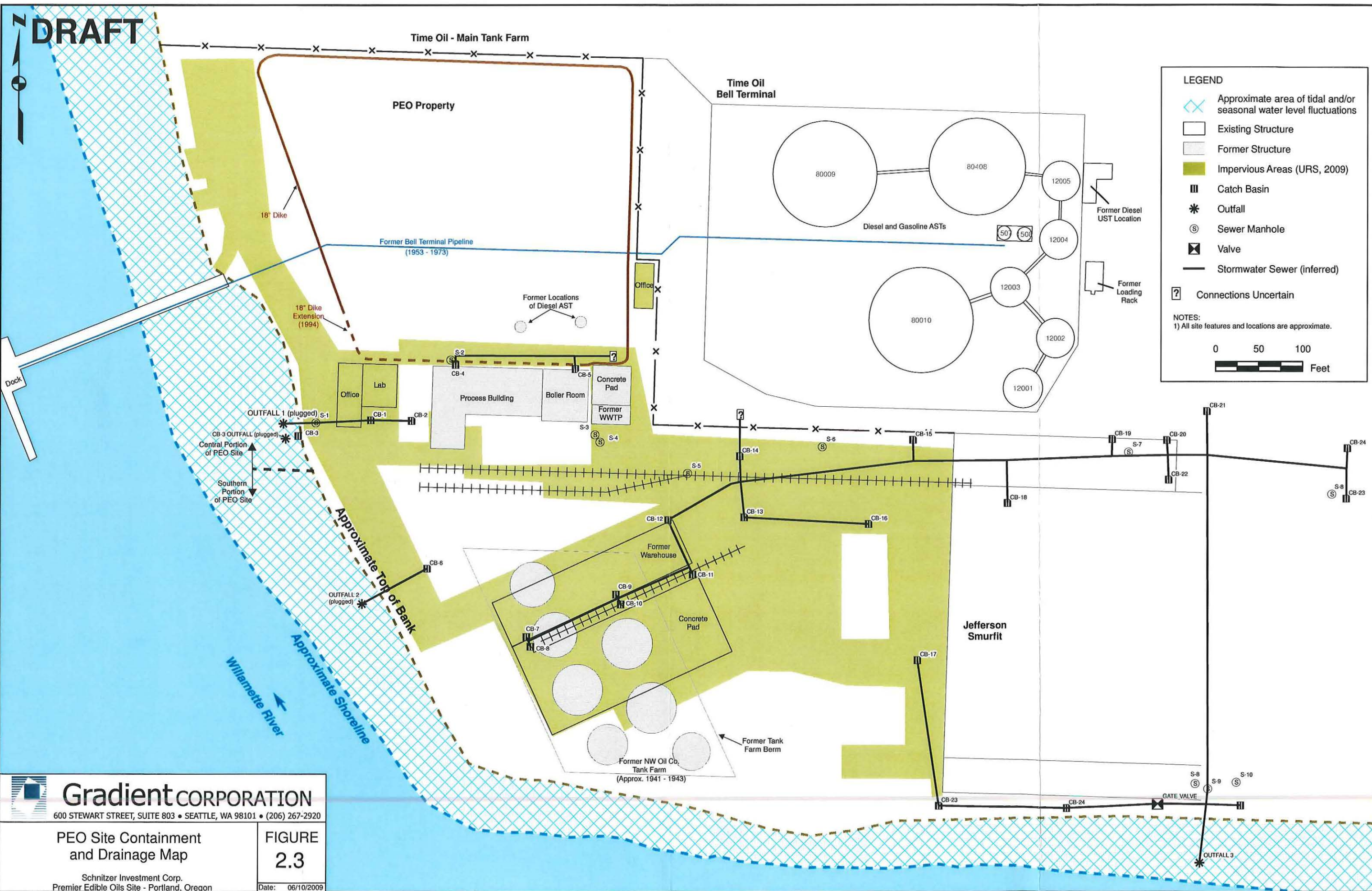
Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE
2.1

Date: 06/10/2009



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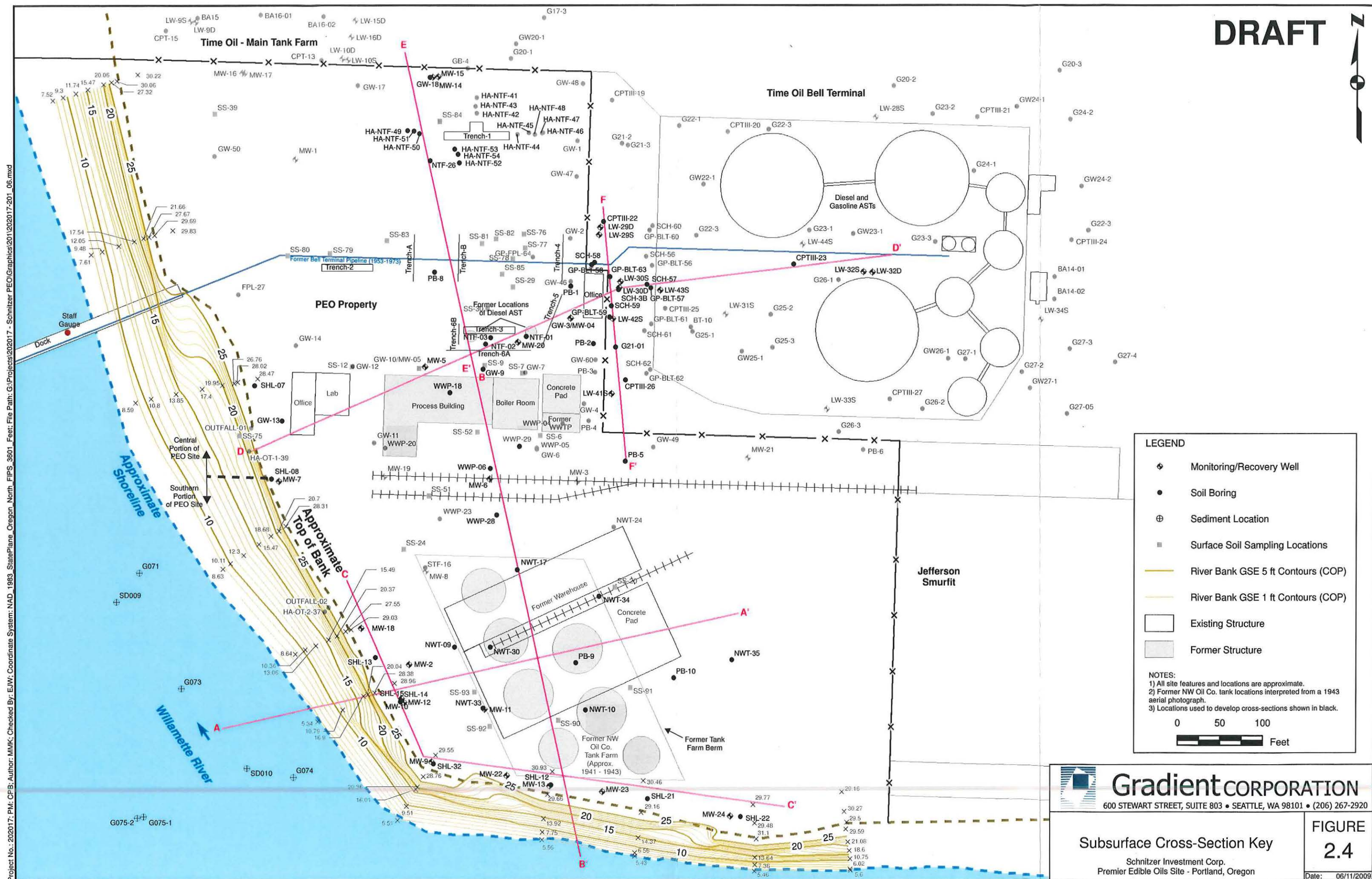
Gradient CORPORATION
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PEO Site Containment and Drainage Map

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

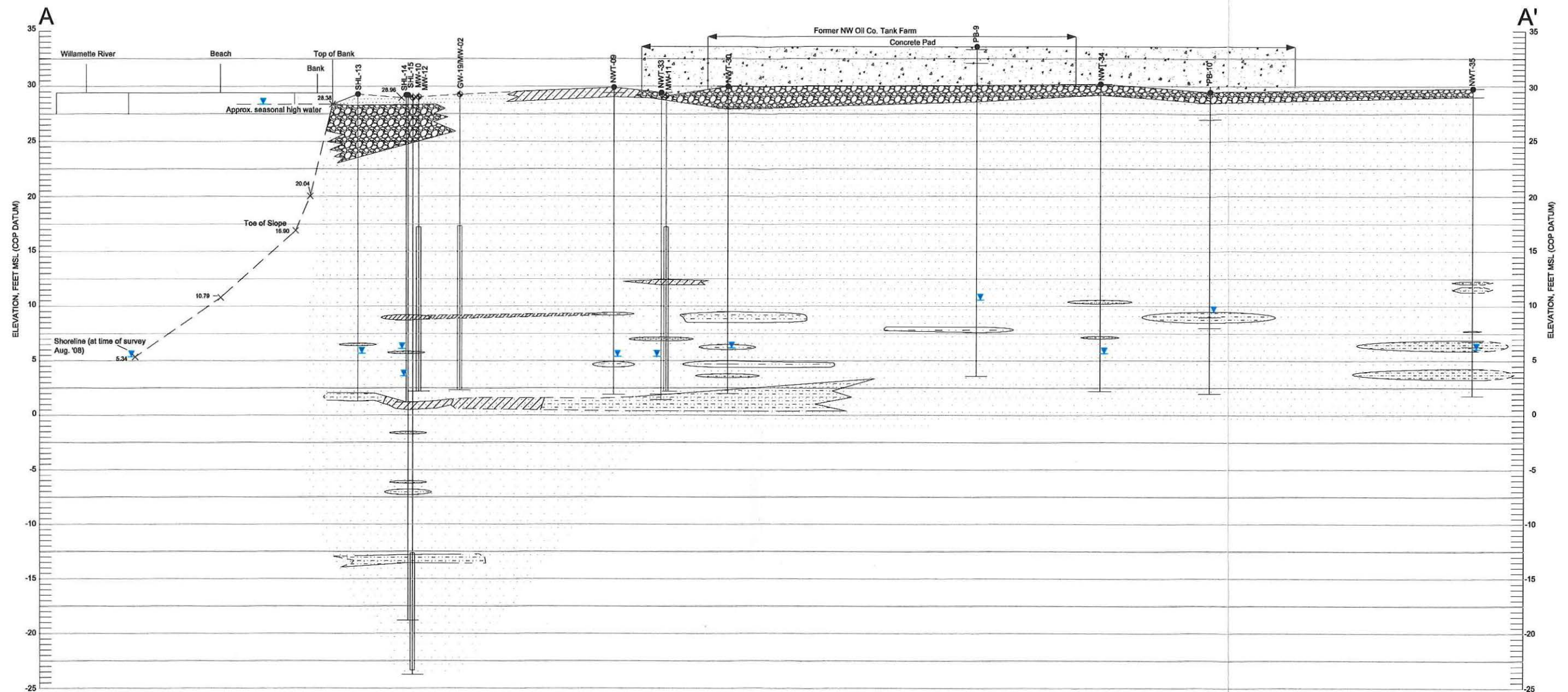
FIGURE 2.3

Date: 06/10/2009

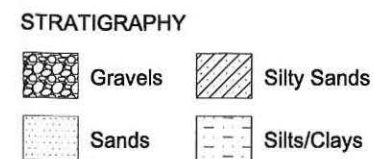
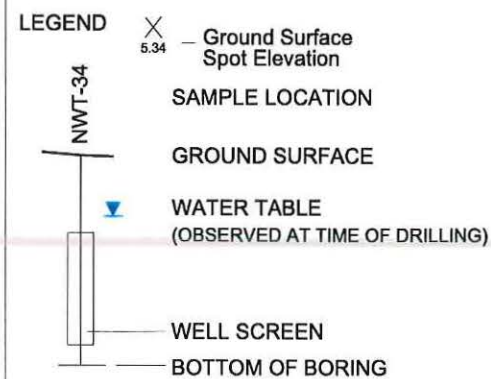
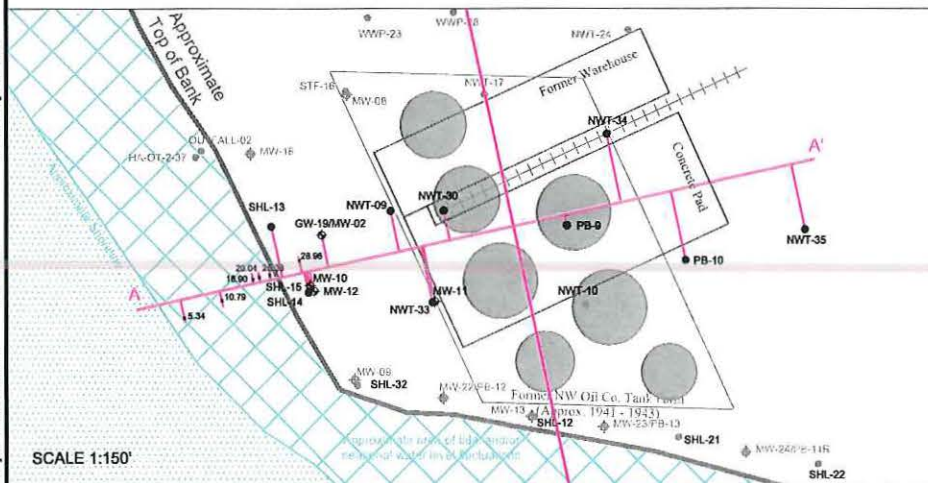




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0 20 40 Feet
VERTICAL SCALE: EXAGGERATED 4X



NOTES:
1) Borings shown as dark gray indicates no stratigraphy data available at that location.
2) COP elevation - 1.375 ft = NGVD29 elevation
COP elevation + 2.10 ft = NAVD88 elevation
3) Surface features projected perpendicular to cross-section.



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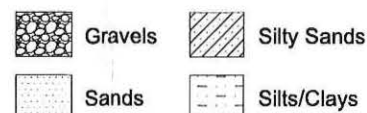
Cross Section A-A'

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE
2.5

Date: 06/11/2009

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NOTES:

- 1) Borings shown as dark grey indicates no stratigraphy data available at that location.
- 2) COP elevation - 1.375 ft = NGVD29 elevation
COP elevation + 2.10 ft = NAVD88 elevation
- 3) Surface features projected perpendicular to section.



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Cross Section B-B'

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

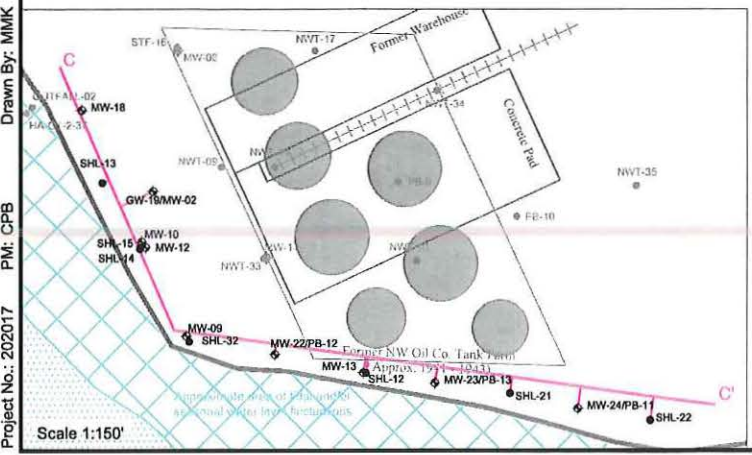
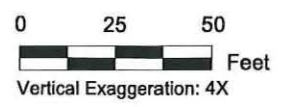
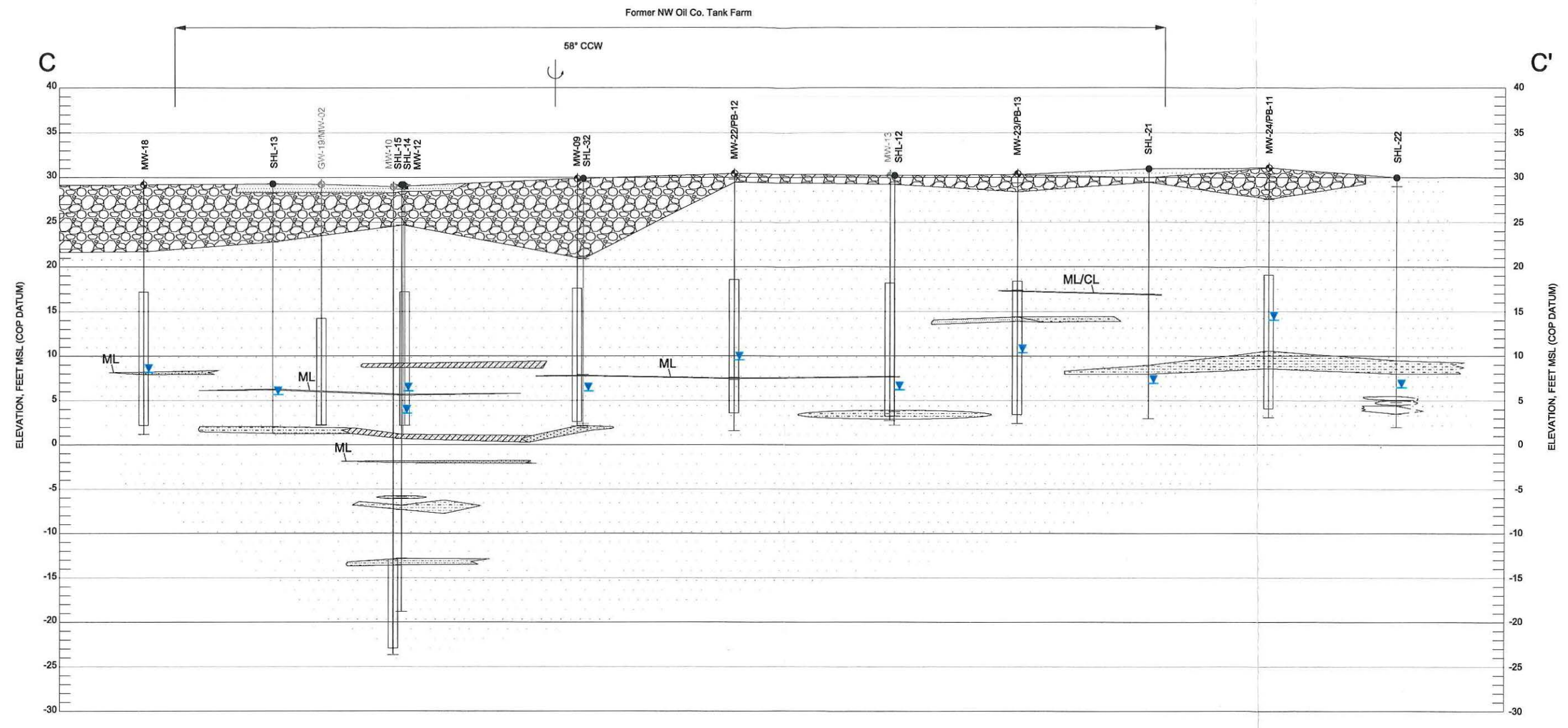
FIGURE
2.6

Date: 06/11/2009

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LEGEND

NWT-34

GROUND SURFACE

WATER TABLE (OBSERVED AT TIME OF DRILLING)

WELL SCREEN

BOTTOM OF BORING

STRATIGRAPHY

Gravels	Silty Sands
Sands	Silts/Clays

NOTES:

- 1) Borings shown as dark grey indicates no stratigraphy data available at that location.
- 2) CCW = counter clockwise.
- 3) COP elevation - 1.375 ft = NGVD29 elevation
COP elevation + 2.10 ft = NAVD88 elevation
- 4) Surface features projected perpendicular to section.

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Cross Section C-C'

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

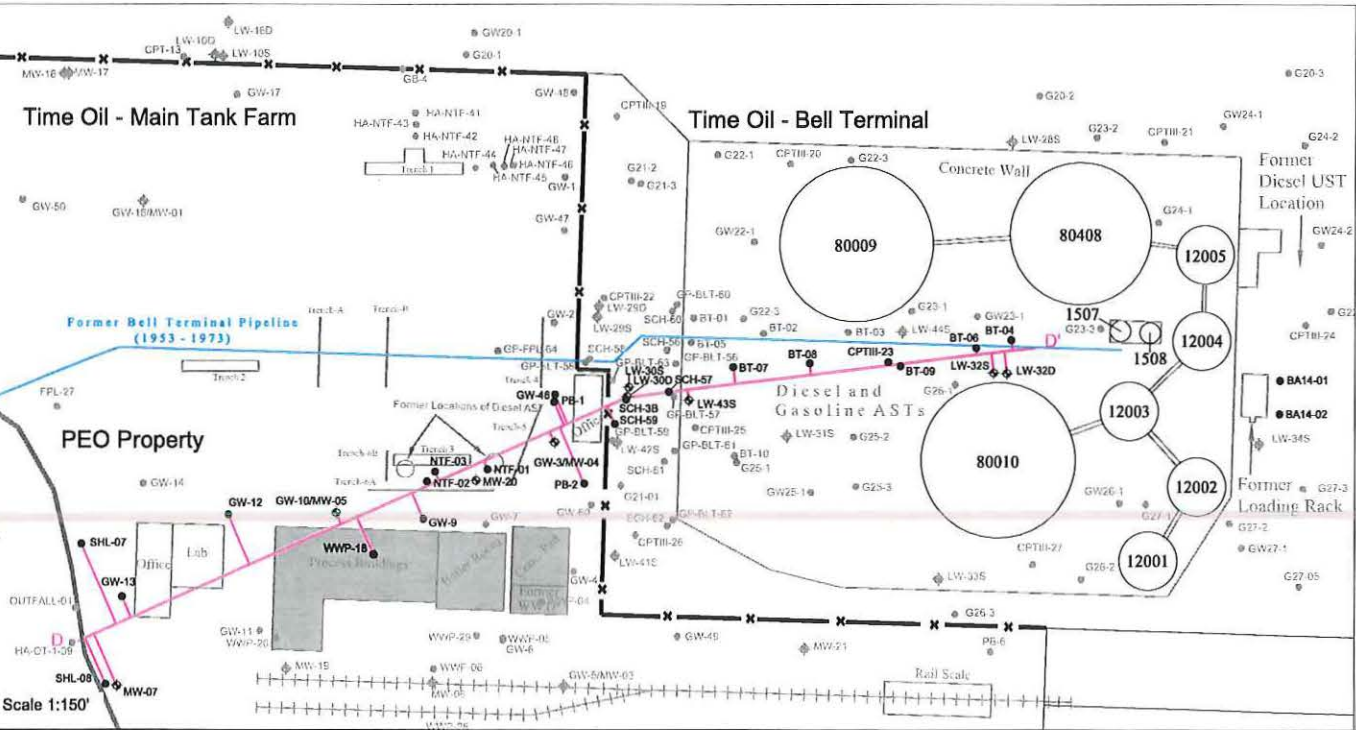
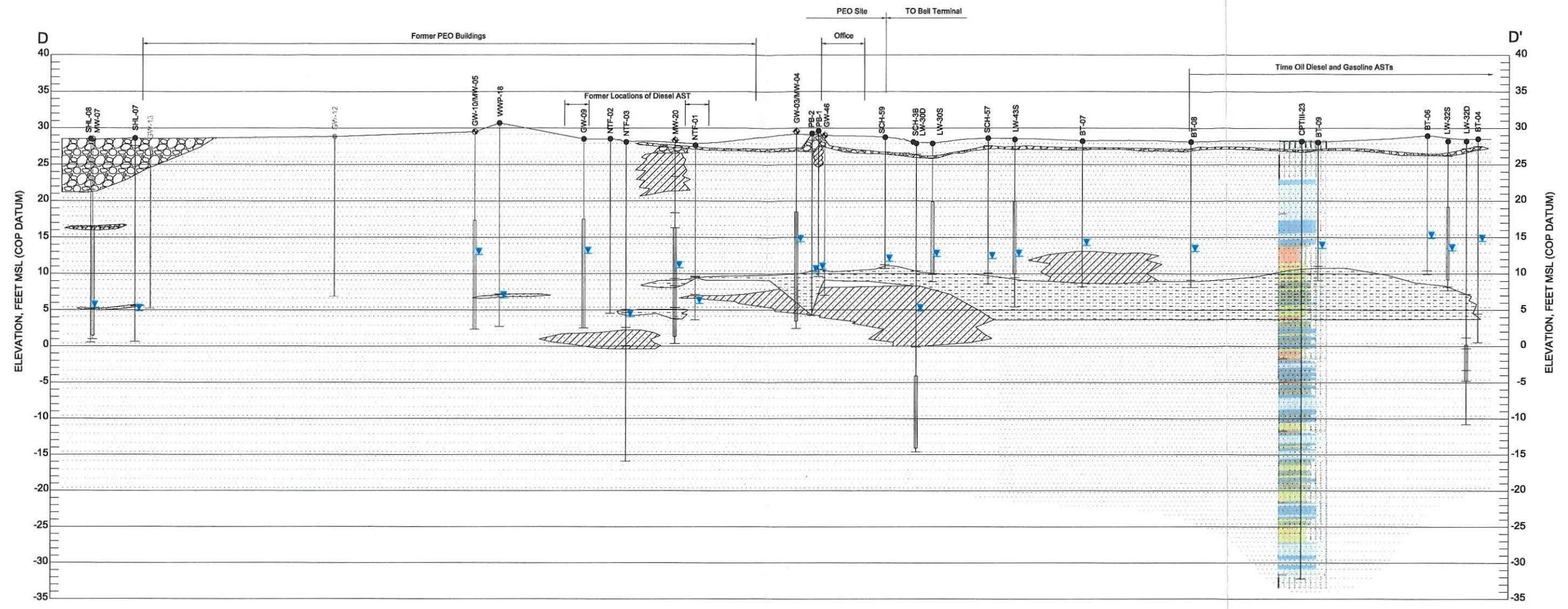
FIGURE 2.7

Date: 06/11/2009

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LEGEND

CPT - INFERRED STRATIGRAPHY

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

STRATIGRAPHY

Gravels	Silty Sands
Sands	Silts/Clays

NOTES:

- 1) Borings shown as dark grey indicates no stratigraphy data available at that location.
- 2) COP elevation - 1.375 ft = NGVD29 elevation
COP elevation + 2.10 ft = NAVD88 elevation
- 3) Surface features projected perpendicular to section.
- 4) Illegible colors in CPT-inferred stratigraphy from Time Oil's Phase III RI report.

Scale: 0 30 60 Feet
Vertical Exaggeration: 4X

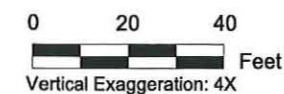
Gradient CORPORATION
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Cross Section D-D'

FIGURE 2.8

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

Date: 06/09/2009



— WELL SCREEN
— BOTTOM OF BORING



Silts/Clays

- NOTES:
- 1) Borings shown as dark grey indicates no stratigraphy data available at that location.
 - 2) COP elevation - 1.375 ft = NGVD29 elevation
COP elevation + 2.10 ft = NAVD88 elevation
 - 3) Surface features projected perpendicular to section.

Gradient CORPORATION

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

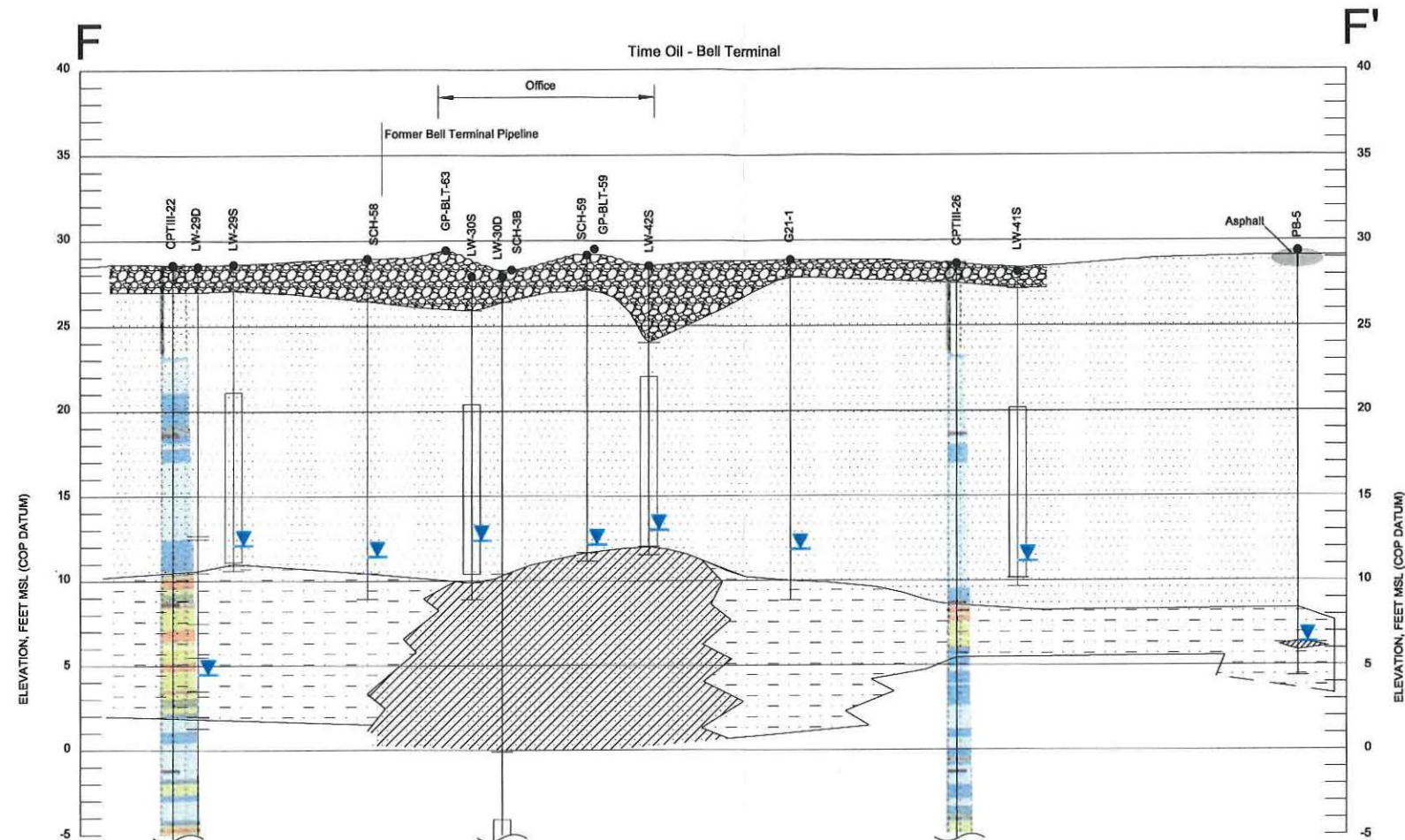
FIGURE 2.9

Date: 06/09/2009

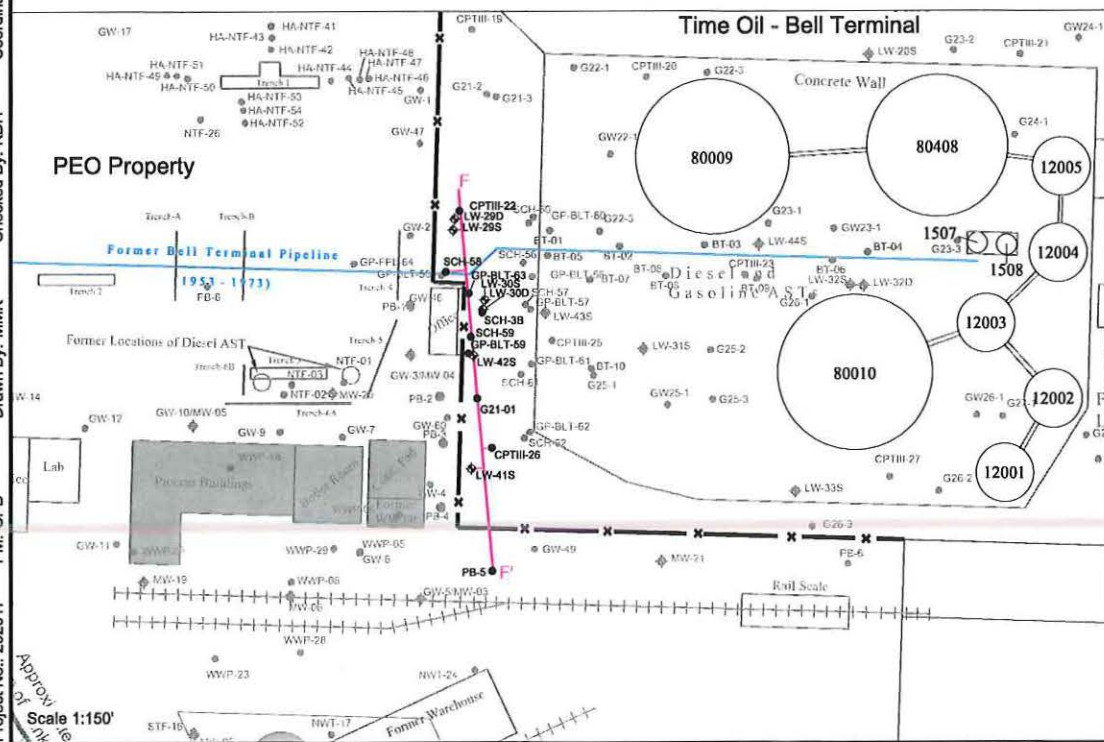
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Note: CPTIII-22, LW-29D, LW-30D AND CPTIII-26 continue to greater depths.



LEGEND

- SAMPLE LOCATION
- GROUND SURFACE
- WATER TABLE (BASED ON OBSERVATION)
- WELL SCREEN

STRATIGRAPHY

- Gravels
- Silty Sands
- Sands
- Silts/Clays

CPT - INFERRED STRATIGRAPHY

- | | | | |
|--------------------------|-----------------------------|----------------------------|--------------------------------|
| 1 sensitive fine grained | 4 silty clay to clay | 7 silty sand to sandy silt | 10 gravelly sand to sand |
| 2 organic material | 5 clayey silt to silty clay | 8 sand to silty sand | 11 very stiff fine grained (*) |
| 3 clay | 6 sandy silt to clayey silt | 9 sand | 12 sand to clayey sand (*) |

NOTE:
1) Borings shown as dark grey indicates no stratigraphy data available at that location.
2) Illegible colors in CPT-inferred stratigraphy from Time Oil's Phase III RI report.



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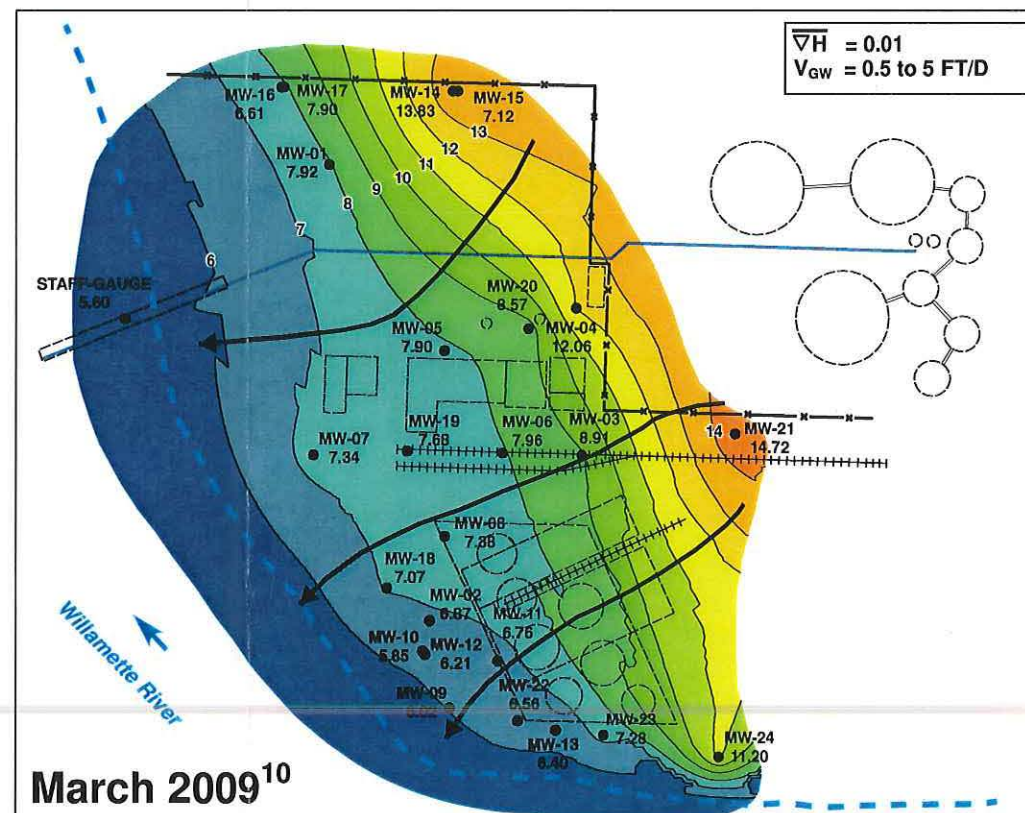
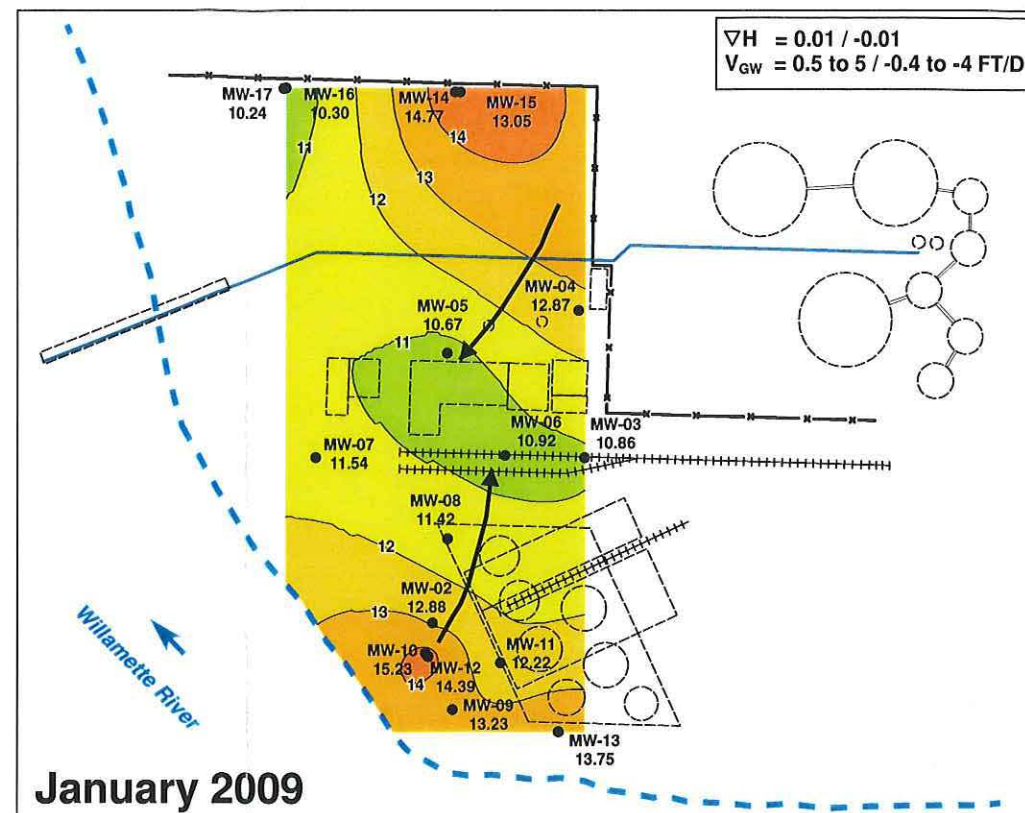
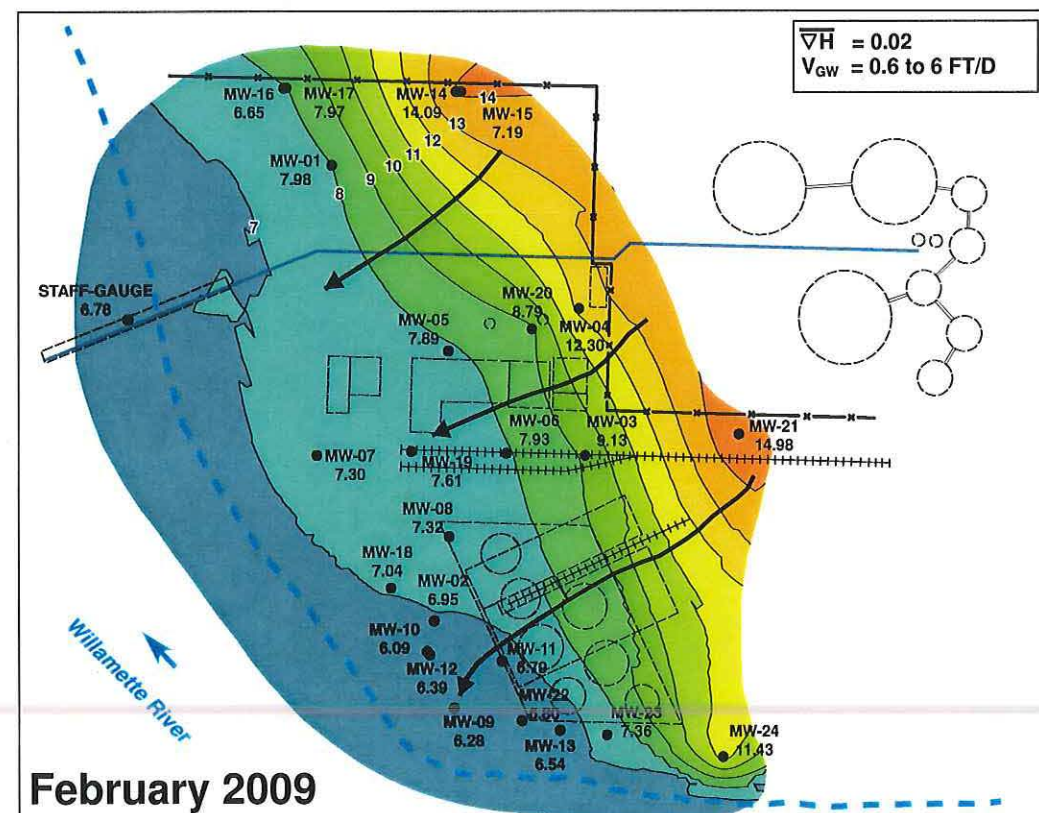
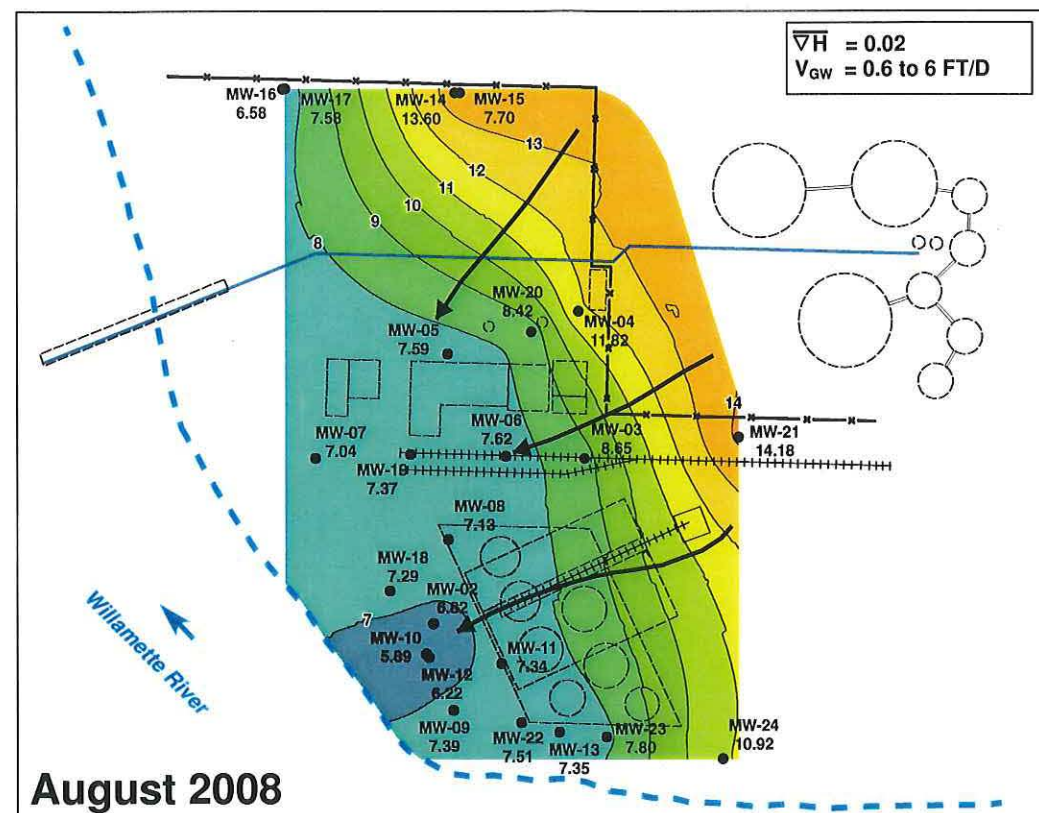
Cross Section F-F'

FIGURE
2.10

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

Date: 06/11/2009

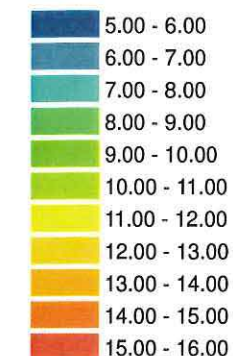
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LEGEND

- Monitoring Well Locations
- Shoreline (Approx.)

Water Table Elevation Contours (ft, COP datum)



$$\nabla H = \text{Average Hydraulic Gradient}^1$$

$$V_{GW} = \text{Groundwater Velocity}^2$$



- NOTES:**
- 1) Positive hydraulic gradient indicates flow toward river; negative indicates flow toward site. Average values were calculated using/along all groundwater flow direction arrows (except January 2009).
 - 2) Calculated using a hydraulic conductivity of 10 to 100 feet/day (8) and an effective porosity of 30% (9).
 - 3) Based on data collected and provided by URS.
 - 4) Water table elevation (WTE) contours produced with data collected on Feb. 16 and 17, 2008 from staff gauge at dock and monitoring wells MW-02, MW-07, MW-08, MW-09, MW-11, MW-12, MW-13, MW-18, MW-22, MW-23, and MW-24.
 - 5) MW-10, MW-15, and MW-16 are from a deeper groundwater zone -- shown but excluded from contour plotting.
 - 6) Constant head boundary condition defined along Willamette River shoreline as reported staff gauge values (shown at "STAFF-GAUGE" location).
 - 7) Contours produced via Kriging interpolation in ArcMap 9.3 with Geostatistical Analyst (default settings).
 - 8) Hydraulic conductivity values (k) based on assumed representative values for sand (Domenico & Schwartz, 1998; US EPA, 1998).
 - 9) Effective porosity (ne) based on assumed representative value for sand (Domenico & Schwartz, 1998).
 - 10) There were three staff gauge measurements taken during the March 2009 sampling round (all measurements taken March 12, 2009, between 4 and 5:30 PM). The average of these three values was used as the staff gauge surface water elevation and the boundary condition.
 - 11) No staff gauge measurements available for August 2008 and January 2009.
 - 12) WTE calculation methodology outlined here:

$$\text{Equivalent DTW} = \text{DTW} - (\text{PT} \times \text{LNAPL specific gravity})$$

$$\text{WTE} = Z - \text{Equivalent DTW}$$

Where:
 Depth to water (DTW, ft below top of casing)
 Product thickness (PT, ft)
 Elevation (Z, ft)



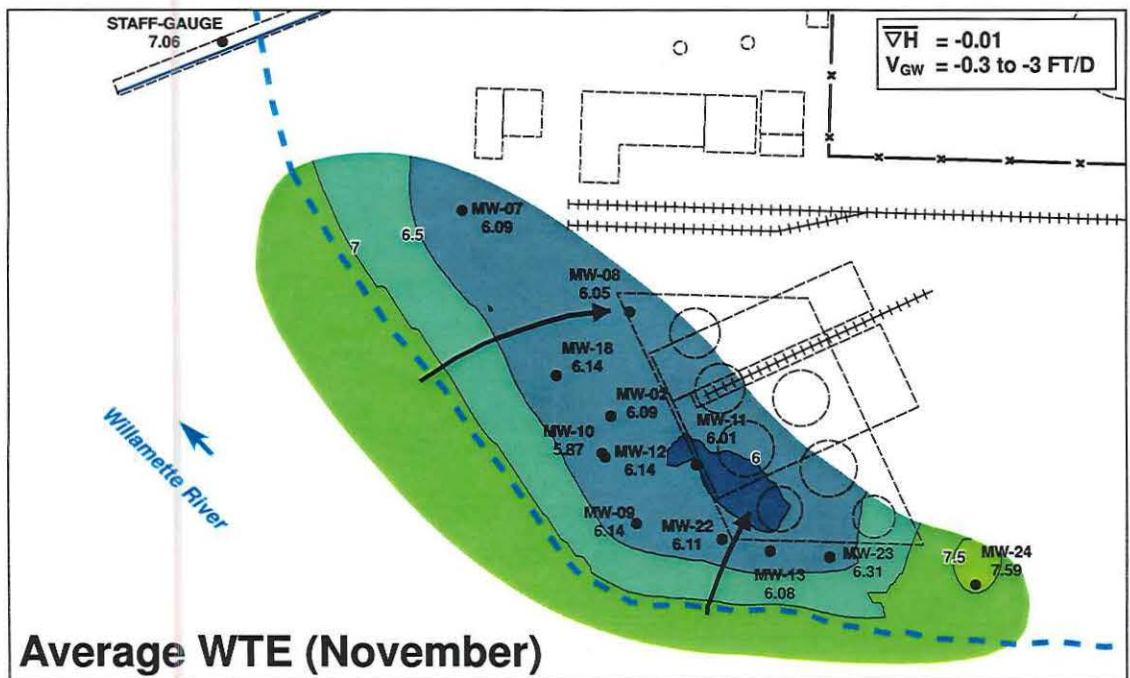
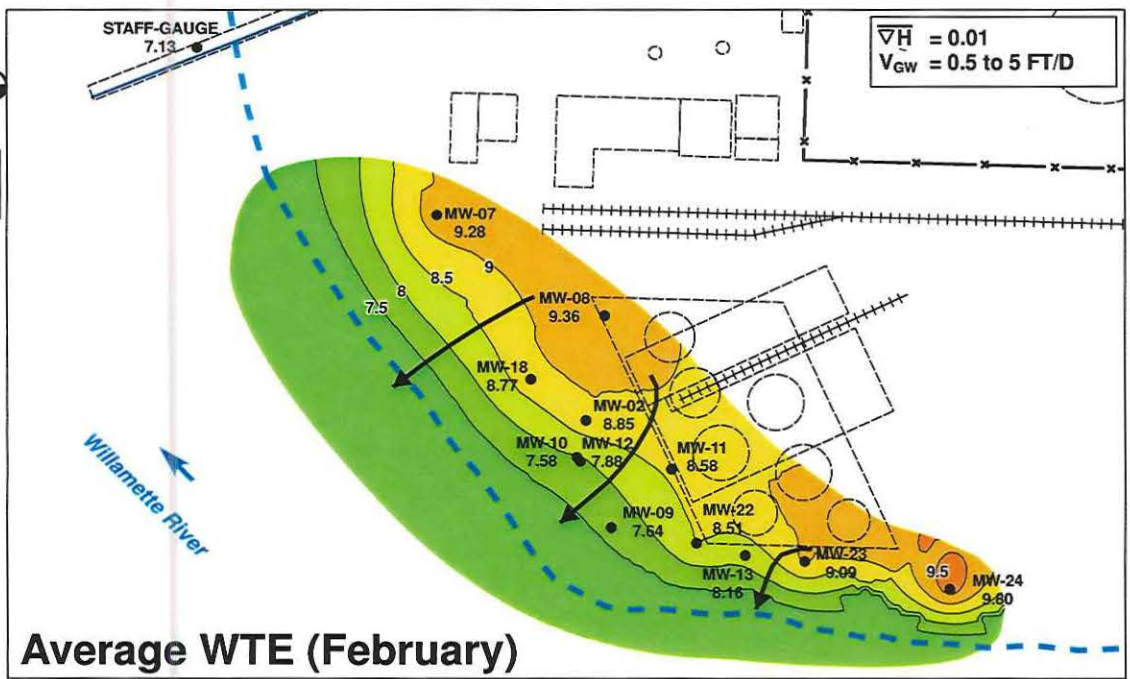
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Site-Wide WTE Contours -
 2008 and 2009
 Schnitzer Investment Corp.
 Premier Edible Oils Site - Portland, Oregon

FIGURE
2.11

Date: 06/09/2009

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LEGEND

- Monitoring Well Locations
- Shoreline (Approx.)

Water Table Elevation Contours (ft, COP datum)

- 5.50 - 6.00
- 6.00 - 6.50
- 6.50 - 7.00
- 7.00 - 7.50
- 7.50 - 8.00
- 8.00 - 8.50
- 8.50 - 9.00
- 9.00 - 9.50
- 9.50 - 10.00
- 10.00 - 10.50

$\bar{\nabla}H = \text{Average Hydraulic Gradient}^1$
 $V_{GW} = \text{Groundwater Velocity}^2$

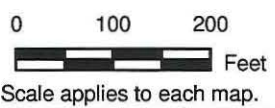


NOTES:

- 1) Positive hydraulic gradient indicates flow toward river; negative indicates flow toward site. Average values were calculated using/along all groundwater flow direction arrows.
- 2) Calculated using a hydraulic conductivity of 10 to 100 feet/day (8) and an effective porosity of 30% (9).
- 3) Based on data collected and provided by URS.
- 4) Water table elevation (WTE) contours produced with data collected on Feb. 16 and 17, 2008 from staff gauge at dock and monitoring wells MW-02, MW-07, MW-08, MW-09, MW-11, MW-12, MW-13, MW-18, MW-22, MW-23, and MW-24.
- 5) MW-10 is from a deeper groundwater zone -- shown but excluded from contour plotting.
- 6) Constant head boundary condition defined along Willamette River shoreline as reported staff gauge values (shown at "STAFF-GAUGE" location).
- 7) Contours produced via Kriging interpolation in ArcMap 9.3 with Geostatistical Analyst (default settings).
- 8) Hydraulic conductivity values (k) based on assumed representative values for sand (Domenico & Schwartz, 1998; US EPA, 1998).
- 9) Effective porosity (ne) based on assumed representative value for sand (Domenico & Schwartz, 1998).
- 10) WTE calculation methodology outlined here:

Equivalent DTW = DTW - (PT * LNAPL specific gravity)
WTE = Z - Equivalent DTW

Where:
Depth to water (DTW, ft below top of casing)
Product thickness (PT, ft)
Elevation (Z, ft)



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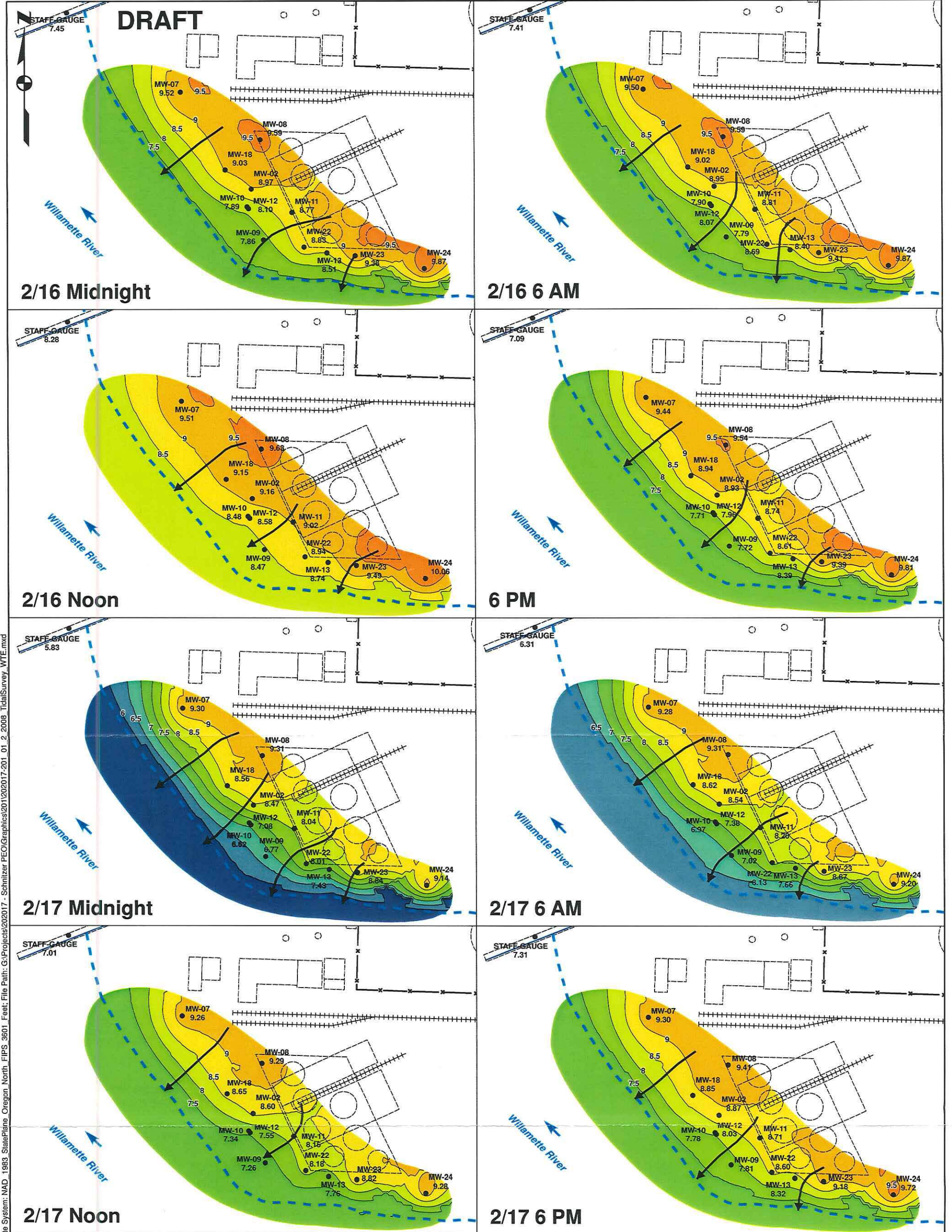
2008 WTE Contours Tidal Comparison
February vs. November

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE 2.12

Date: 06/09/2009

Project No.: 202017; PM: KDH; Author: JMA; Checked By: JMA; Coordinate System: NAD 1983 StatePlane_Oregon_North FIPS 3601 Feet; File Path: 202017-201_03.mxd



LEGEND

- Monitoring Well Locations
 - Shoreline (Approx.)
 - Water Table Elevation Contours (ft, COP datum)
 - 5.50 - 6.00
 - 6.00 - 6.50
 - 6.50 - 7.00
 - 7.00 - 7.50
 - 7.50 - 8.00
 - 8.00 - 8.50
 - 8.50 - 9.00
 - 9.00 - 9.50
 - 9.50 - 10.00
 - 10.00 - 10.50
- Approximate Groundwater Flow Direction

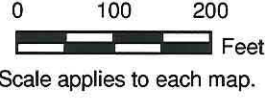
NOTES:

- 1) Based on data collected and provided by URS.
- 2) Water table elevation (WTE) contours produced with data collected on Feb. 16 and 17, 2008 from staff gauge at dock and monitoring wells MW-02, MW-07, MW-08, MW-09, MW-11, MW-12, MW-13, MW-18, MW-22, MW-23, and MW-24.
- 3) MW-10 is from a deeper groundwater zone -- shown but excluded from contour plotting.
- 4) Constant head boundary condition defined along Willamette River shoreline as reported staff gauge values (shown at "STAFF-GAUGE" location).
- 5) Contours produced via Kriging interpolation in ArcMap 9.3 with Geostatistical Analyst (default settings).
- 6) Measurements taken +/- 1 hour from posted time (generally +/- 15 minutes), except for MW-13 at midnight on Feb. 16 (used WTE collected at 1:21 AM due to measurement errors at earlier times).
- 7) WTE calculation methodology outlined here:

Equivalent DTW = DTW - (PT * LNAPL specific gravity)
WTE = Z - Equivalent DTW

Where:

- Depth to water (DTW, ft below top of casing)
- Product thickness (PT, ft)
- Elevation (Z, ft)



Scale applies to each map.



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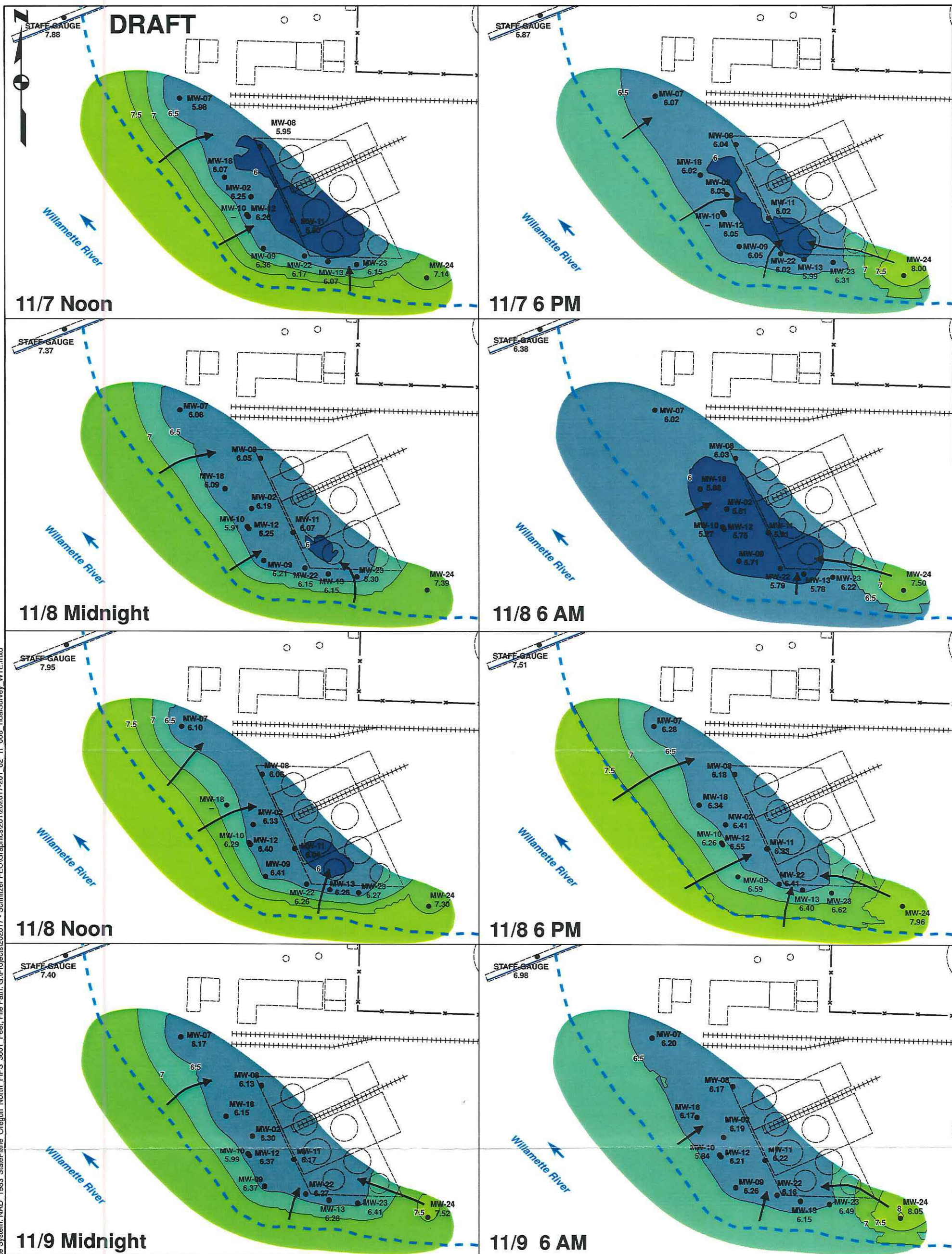
**February 2008 Tidal Survey
WTE Contours at 6 Hour Intervals**

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

**FIGURE
2.13**

Date: 06/09/2009

Project No.: 202017; PM: KDH; Author: JMA; Checked By: JMA; Coordinate System: NAD 1983 StatePlane Oregon North FIPS 3601 Feet; File Path: G:\Projects\202017 - Schnitzer PEO\Graphics\201202017-201_02_11_008 TidalSurvey WTE.mxd

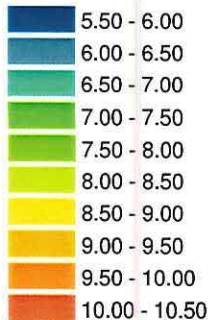


LEGEND

● Monitoring Well Locations

--- Shoreline (Approx.)

Water Table Elevation Contours (ft, COP datum)



Approximate Groundwater Flow Direction

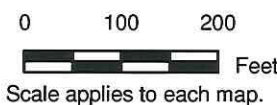
NOTES:

- 1) Based on data collected and provided by URS.
- 2) Water table elevation (WTE) contours produced with data collected on Nov. 7, 8, and 9, 2008 from staff gauge at dock and monitoring wells MW-02, MW-07, MW-08, MW-09, MW-11, MW-12, MW-13, MW-18, MW-22, MW-23, and MW-24.
- 3) MW-10 is from a deeper groundwater zone -- shown but excluded from contour plotting.
- 4) Constant head boundary condition defined along Willamette River shoreline as reported staff gauge values (shown at "STAFF-GAUGE" location).
- 5) Contours produced via Kriging interpolation in ArcMap 9.3 with Geostatistical Analyst (default settings).
- 6) Measurements taken +/- 1 hour from posted time (generally +/- 15 minutes).
- 7) "-" indicates measurement unavailable or erroneous at time interval specified.
- 8) WTE calculation methodology outlined here:

Equivalent DTW = DTW - (PT * LNAPL specific gravity)
WTE = Z - Equivalent DTW

Where:

Depth to water (DTW, ft below top of casing)
Product thickness (PT, ft)
Elevation (Z, ft)



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November 2008 Tidal Survey
WTE Contours at 6 Hour Intervals

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

**FIGURE
2.14**

Date: 06/09/2009

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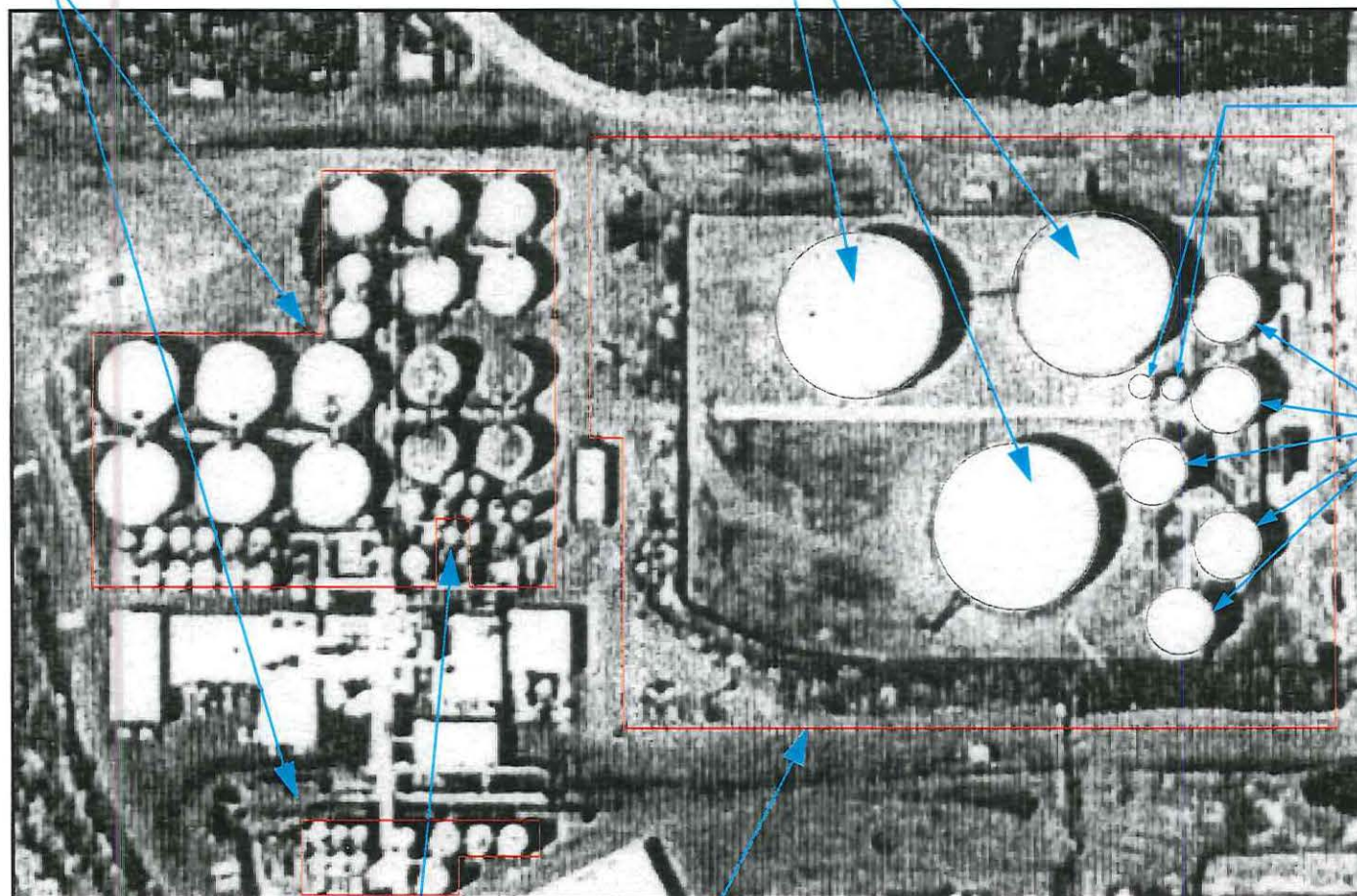


Non-petroleum Storage
(Edible Oil)

3 Large Tanks
Petroleum Storage
3,360,000 gallons each

2 Small Tanks
Petroleum Storage
63,000 gallons each

5 Medium Tanks
Petroleum Storage
504,000 gallons each



PEO Property
1 Diesel Tank - 10,000 gallons

Bell Terminal Property
Total capacity - 12.7 million gallons
Assorted petroleum products



Gradient CORPORATION

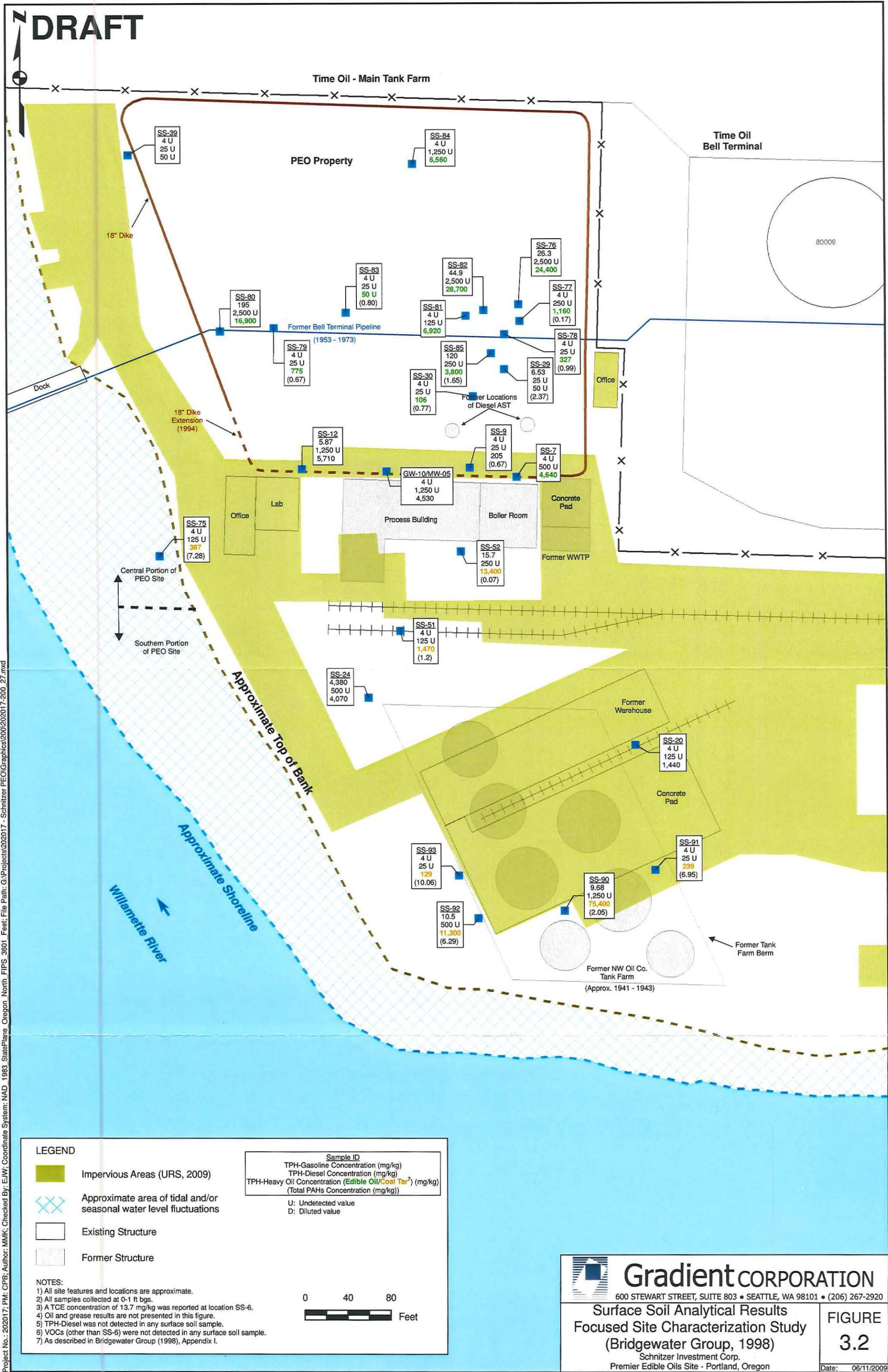
600 STEWART STREET, SUITE 803 • SEATTLE, WA 98101 • (206) 267-2920

Relative Petroleum Product Storage
Capacity at the PEO and
Bell Terminal Sites

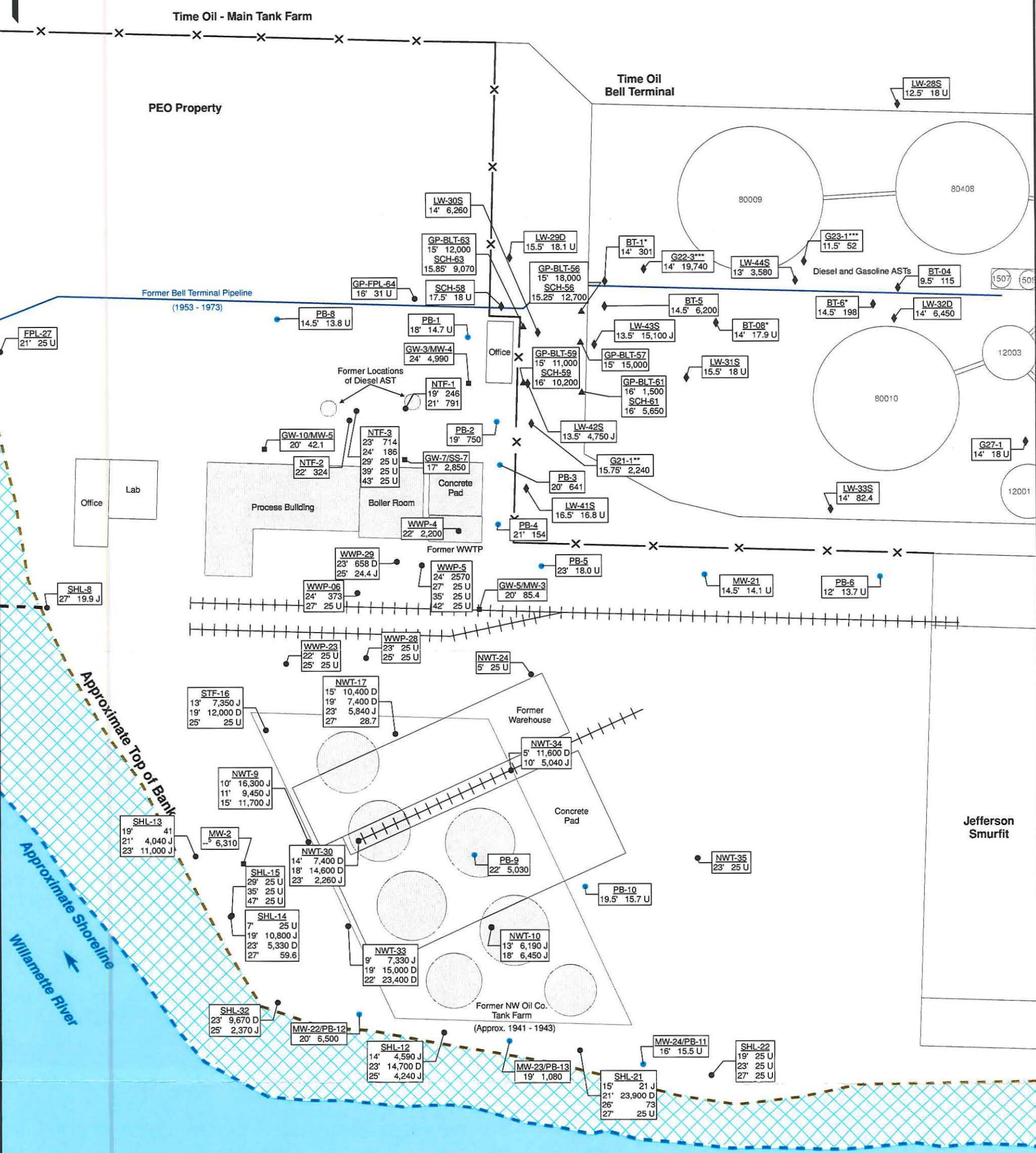
Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

**FIGURE
3.1**

Date: 06/09/2009



Project No.: 202017; PM: CPB; Author: MMK; Checked By: EJJW; Coordinate System: NAD 1983 StatePlane Oregon North FIPS 3601 Feet; File Path: G:\Projects\202017 - Schnitzer PEO\Graphics\300\202017-300_10_Soilgasdiesel.mxd



LEGEND

- Focused Site Characterization (Bridgewater Group, 1998)
 - Remedial Investigation (Bridgewater Group, 2001)
 - ▲ Bell Terminal Samples Collected by Bridgewater Group (Bridgewater Group, 2002)
 - ◆ Bell Terminal Samples Collected by Landau (2003)
 - Additional Characterization (2008)
 - XX Approximate area of tidal and/or seasonal water level fluctuations
 - Existing Structure
 - Former Structure
- | Sample ID | Depth (ft) | TPH-Diesel Concentration (mg/kg) |
|-----------|------------|----------------------------------|
| U | | Undetected value |
| J | | Estimated value |
| D | | Diluted value |
- 0 42.5 85 Feet

NOTES:

- 1) All site features and locations are approximate.
- 2) Former NW Oil Co. tank locations interpreted from a 1943 aerial photograph.
- 3) Smear zone depth range is approximately 15-25 ft bgs.
- 4) "As detailed in Gradient (2006), Attachment B, information regarding sampling depth and TPH-diesel concentrations in groundwater indicates that these soil concentrations may not be representative of actual smear zone conditions and may underestimate TPH concentrations at these locations.
- 5) **Value shown for location G21-1 (2,240 mg/kg) is twice the concentration value reported for each of the two composite soil subsamples collected at locations G21-1 and G21-2.
- 6) ***Values shown for locations G22-3 (19,740 mg/kg) and G23-1 (52 mg/kg) are three times the concentration values reported for each of the three composite soil subsamples collected in Grids 22 and 23.
- 7) Depth not reported for this sample. Based on sampling plan discussed in Bridgewater Group (1998a) and the grouping of this sample with deep soil results (>4 ft bgs) in Bridgewater Group (1998b), assumed to be deep sample.

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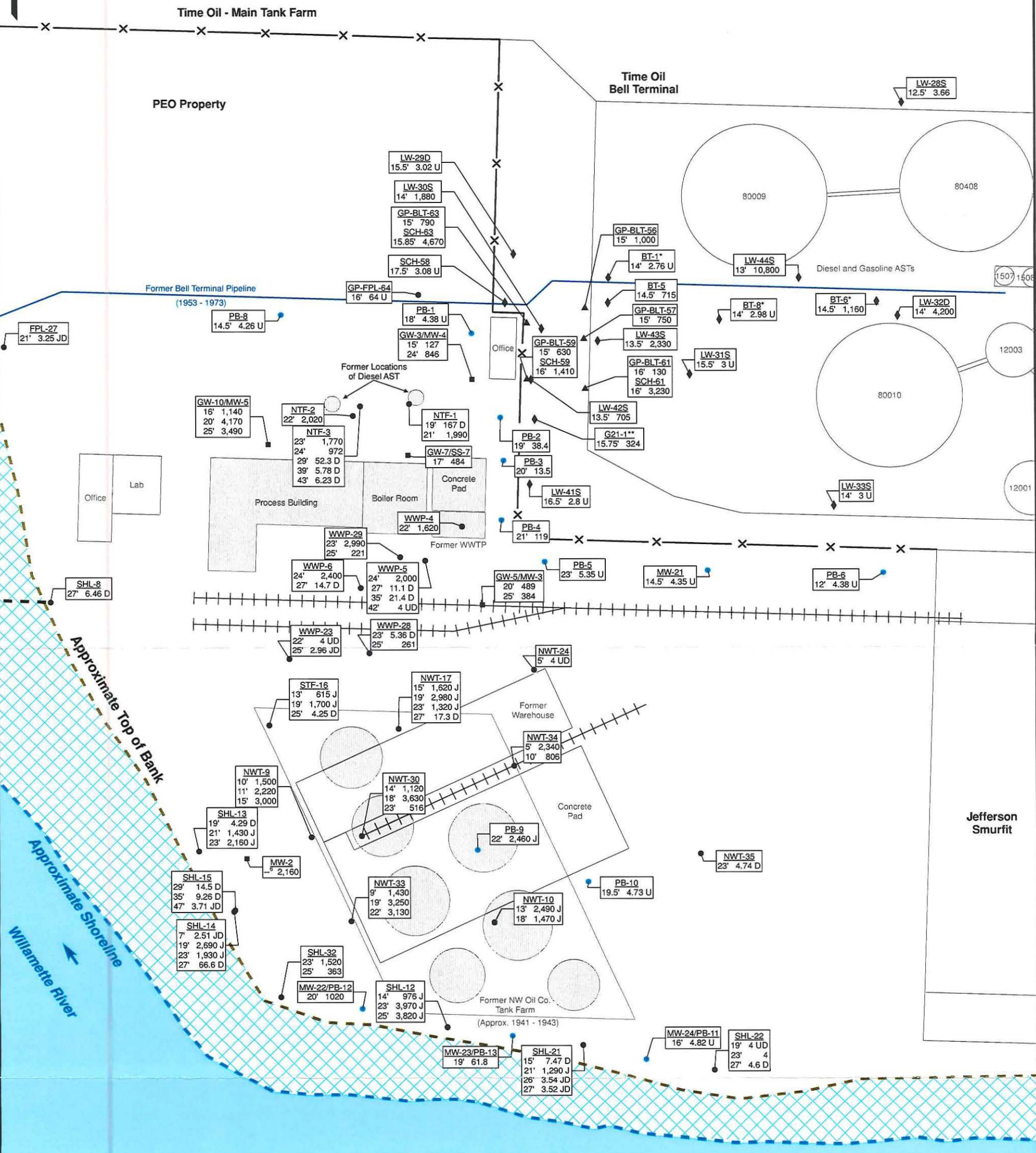
**TPH-Diesel Concentrations
Observed in Soil at Depth (mg/kg)**

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

**FIGURE
3.4**

Date: 05/13/2009

Project No.: 202017; PM: CPB; Author: MMK; Checked By: EJJ; Coordinate System: NAD 1983; StatePlane: Oregon, North; FIPS: 3601; Feet; File Path: G:\Projects\202017 - Schnitzer PEO\Graphics\3000\202017-300_11_Soilgas.mxd



LEGEND

- Focused Site Characterization (Bridgewater Group, 1998)
- Remedial Investigation (Bridgewater Group, 2001)
- ▲ Bell Terminal Samples Collected by Bridgewater Group (Bridgewater Group, 2002)
- ◆ Bell Terminal Samples Collected by Landau (2003)
- Additional Characterization (2008)
- ◇◇◇◇◇ Approximate area of tidal and/or seasonal water level fluctuations
- Existing Structure
- ▒ Former Structure

Sample ID	Depth (ft)	TPH-Gasoline Concentration (mg/kg)
U		Undetected value
J		Estimated value
D		Diluted value

0 42.5 85 Feet

NOTES:

- 1) All site features and locations are approximate.
- 2) Former NW Oil Co. tank locations interpreted from a 1943 aerial photograph.
- 3) Smear zone depth range is approximately 15-25 ft bgs.
- 4) As described in the text, measurements of TPH-gasoline concentrations in soil are typically highly variable due to issues associated with methods for field sampling and chemical analysis.
- 5) *As detailed in Gradient (2006), Attachment B, information regarding sampling depth and TPH-gasoline concentrations in groundwater indicates that these soil concentrations may not be representative of actual smear zone conditions and may underestimate TPH concentrations at these locations.
- 6) **Value shown for location G21-1 (324 mg/kg) is twice the concentration value reported for each of the two composite soil subsamples collected at locations G21-1 and G21-2.
- 7) Depth not reported for this sample. Based on sampling plan discussed in Bridgewater Group (1998a) and the grouping of this sample with deep soil results (>4 ft bgs) in Bridgewater Group (1998b), assumed to be deep sample.

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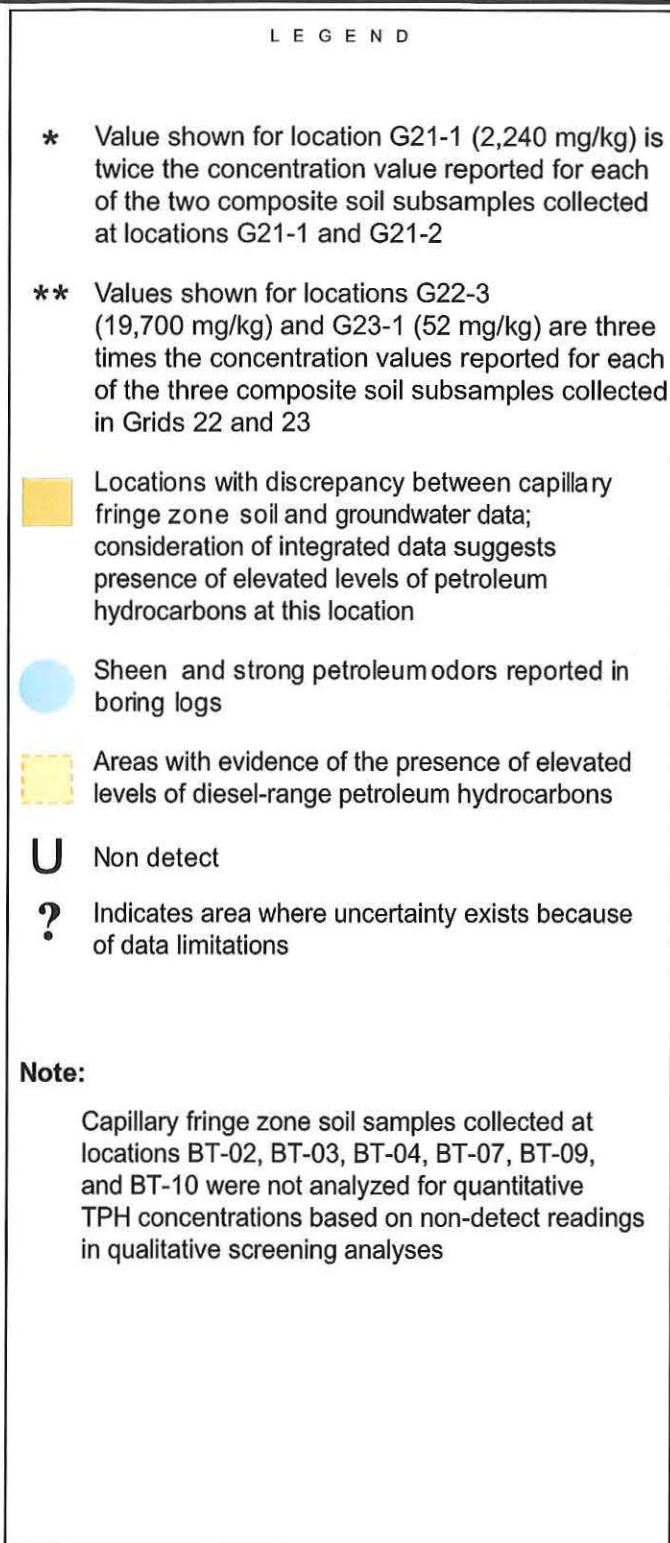
TPH-Gasoline Concentrations Observed in Soil at Depth (mg/kg)

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE 3.5

Date: 05/13/2009

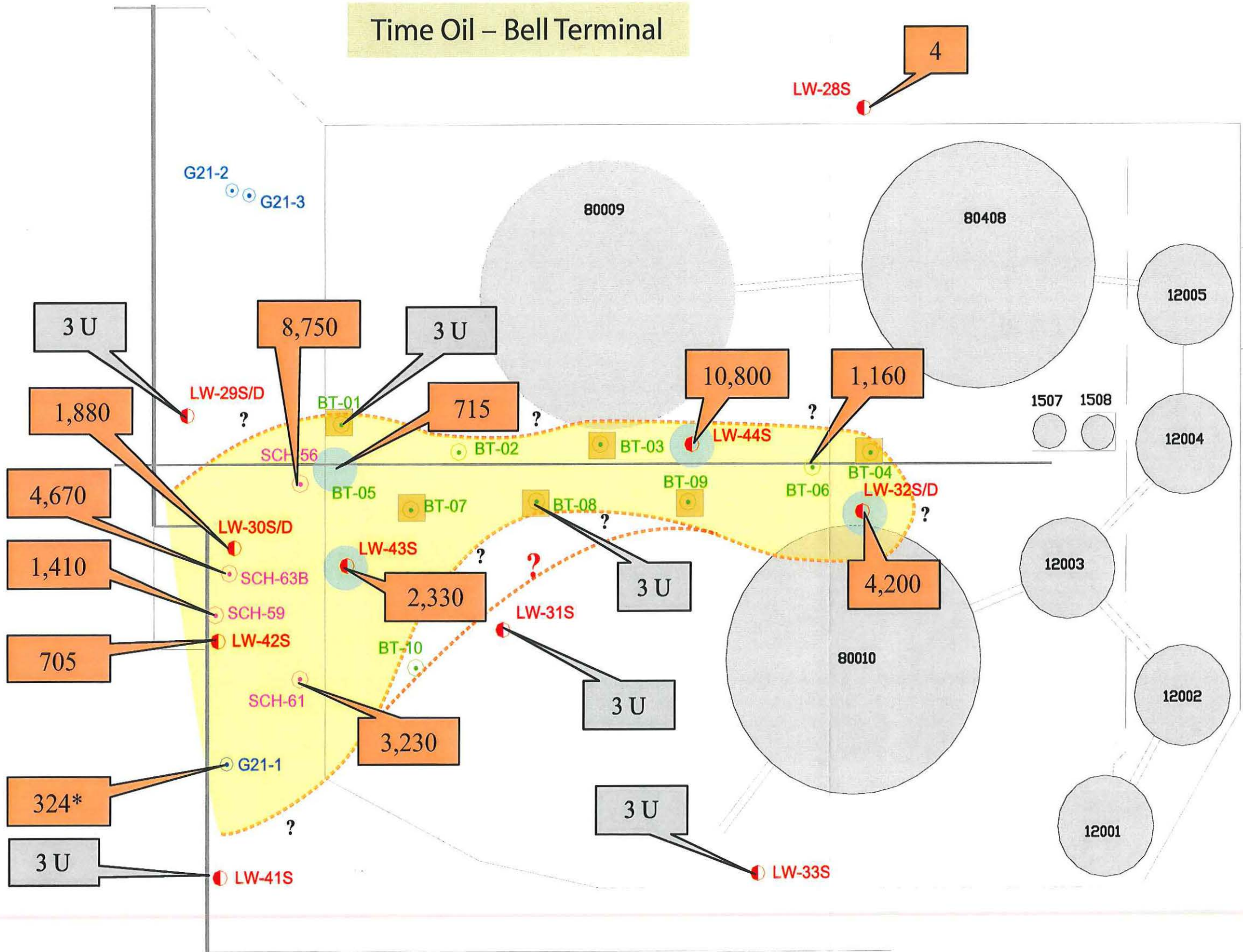
Time Oil – Bell Terminal



 <h1>Gradient CORPORATION</h1> <p>SUITE 803, 600 STEWART STREET • SEATTLE, WA 98101 • (206) 267-2920</p>	
<p>Assessment of Capillary Fringe Zone Soil Results – TPH-Diesel (mg/kg)</p> <p>Schnitzer Investment Corp. Premier Edible Oils Site - Portland, Oregon</p>	<p>FIGURE</p> <p>3.6</p> <p>Date: 01/05/2009</p>

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Time Oil – Bell Terminal



LEGEND

* Value shown for location G21-1 (324 mg/kg) is twice the concentration value reported for each of the two composite soil subsamples collected at locations G21-1 and G21-2

Locations with discrepancy between capillary fringe zone soil and groundwater data; consideration of integrated data suggests presence of elevated levels of petroleum hydrocarbons at this location

Sheen and strong petroleum odors reported in boring logs

Areas with evidence of the presence of elevated levels of gasoline-range petroleum hydrocarbons

U Non detect

? Indicates area where uncertainty exists because of data limitations

Note:
Capillary fringe zone soil samples collected at locations BT-02, BT-03, BT-04, BT-07, BT-09, and BT-10 were not analyzed for quantitative TPH concentrations based on non-detect readings in qualitative screening analyses



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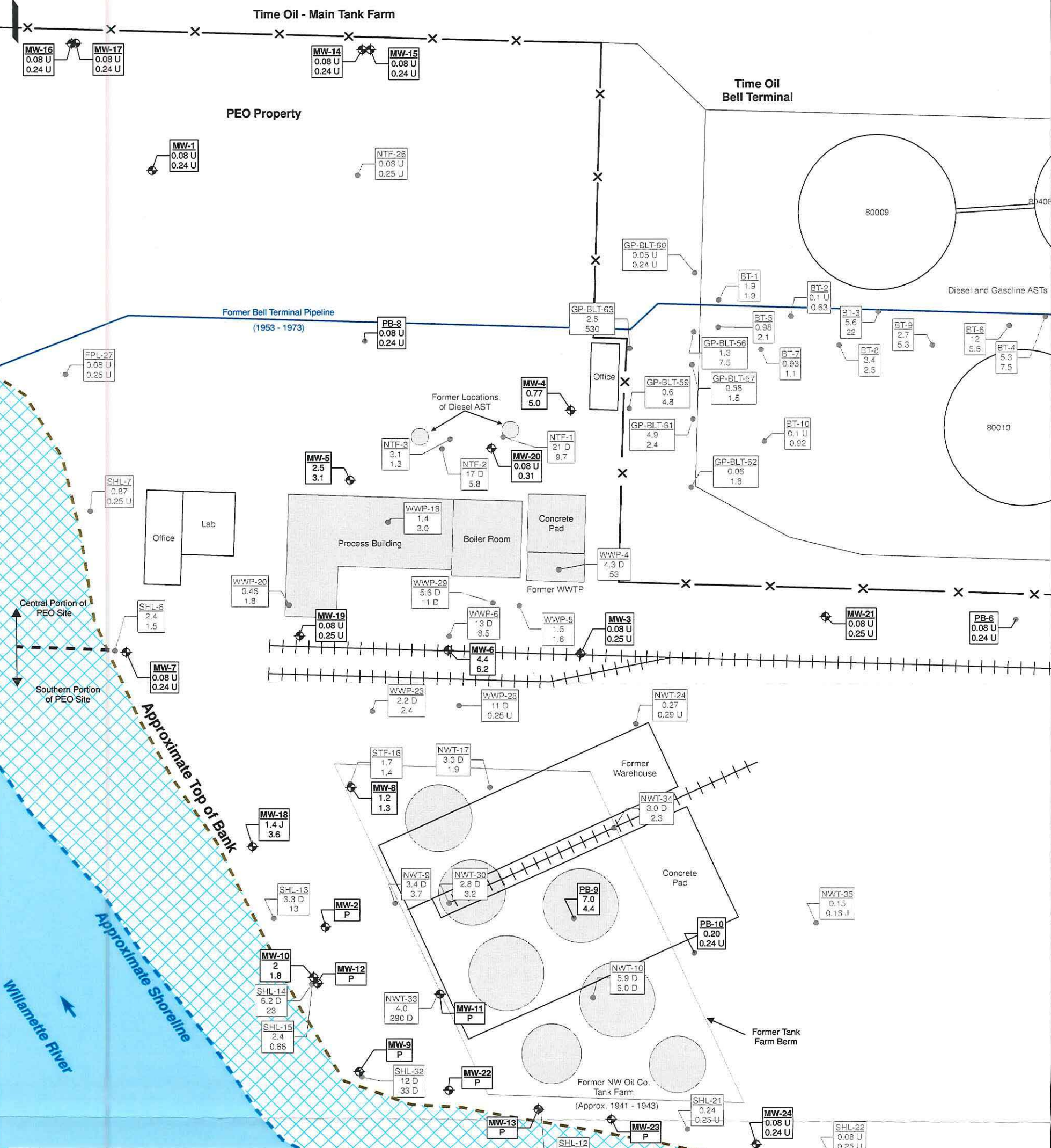
Assessment of Capillary Fringe
Zone Soil Results – TPH-Gasoline (mg/kg)

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE 3.7

Date: 01/05/2009

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LEGEND

- Geoprobe Location
- Monitoring Well Location
- Approximate area of tidal and/or seasonal water level fluctuations
- Existing Structure
- Former Structure

Sample ID
TPH-Gasoline Conc. (mg/L)
TPH-Diesel Conc. (mg/L)

U: Undetected value
J: Estimated value
P: Not sampled due to the presence of free product during selected sampling round

NOTES:

- All site features and locations are approximate.
- Former NW Oil Co. tank locations interpreted from a 1943 aerial photograph.
- PEO property geoprobe samples were collected in May and June, 2001 and February 2008.
- PEO property monitoring well samples were collected in February 2009.
- BLT samples were collected in October, 2001.
- BT samples were collected in July, 2002.
- Note that all wells at the site had an observed product thickness of zero during at least one sampling event.

0 40 80 Feet

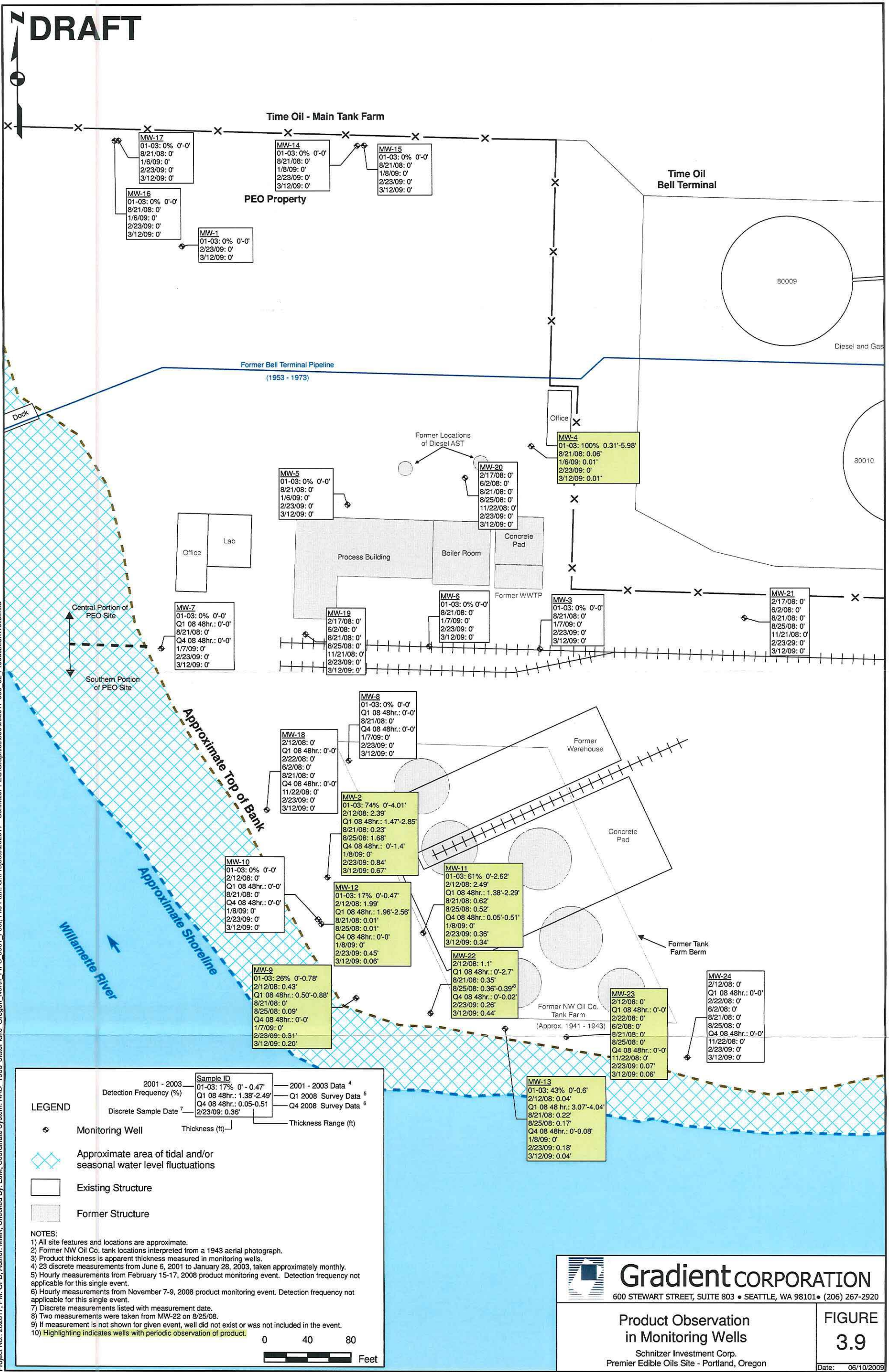
Gradient CORPORATION
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TPH-Gasoline and TPH-Diesel Concentrations in Groundwater (mg/L)

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE 3.8

Date: 06/02/2009



Project No.: 202017; PM: CPB; Author: MMK; Checked By: EJM; Coordinate System: NAD 1983 StatePlane Oregon North FIPS 3601 Feet; File Path: G:\Projects\202017 - Schnitzer PEO\Graphics\300\202017-300_02 ProductMonWells.mxd

LEGEND

- Monitoring Well
- Approximate area of tidal and/or seasonal water level fluctuations
- Existing Structure
- Former Structure

- NOTES:
- All site features and locations are approximate.
 - Former NW Oil Co. tank locations interpreted from a 1943 aerial photograph.
 - Product thickness is apparent thickness measured in monitoring wells.
 - 23 discrete measurements from June 6, 2001 to January 28, 2003, taken approximately monthly.
 - Hourly measurements from February 15-17, 2008 product monitoring event. Detection frequency not applicable for this single event.
 - Hourly measurements from November 7-9, 2008 product monitoring event. Detection frequency not applicable for this single event.
 - Discrete measurements listed with measurement date.
 - Two measurements were taken from MW-22 on 8/25/08.
 - If measurement is not shown for given event, well did not exist or was not included in the event.
 - Highlighting indicates wells with periodic observation of product.

0 40 80 Feet



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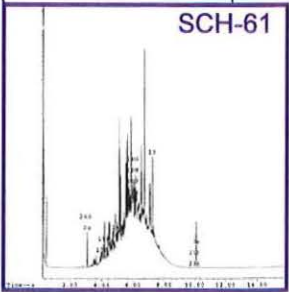
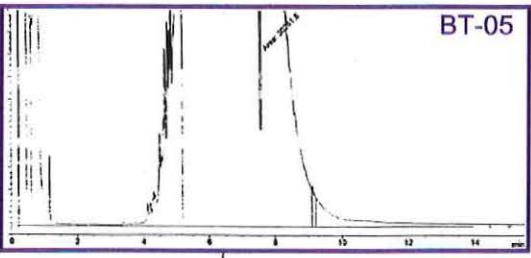
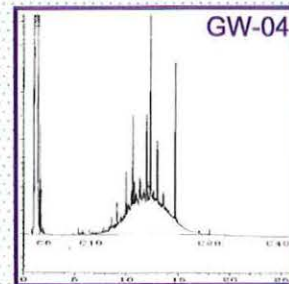
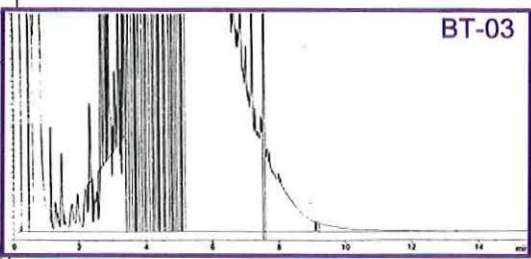
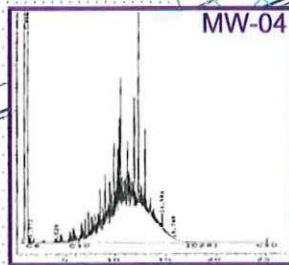
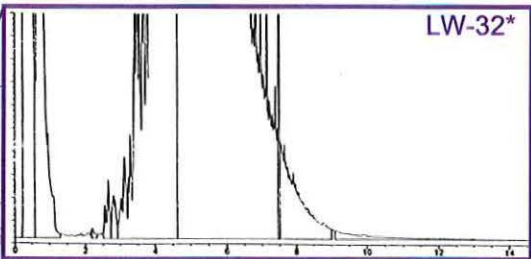
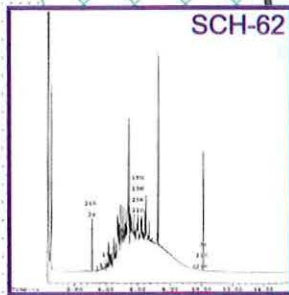
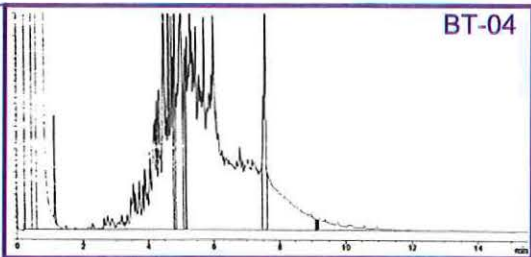
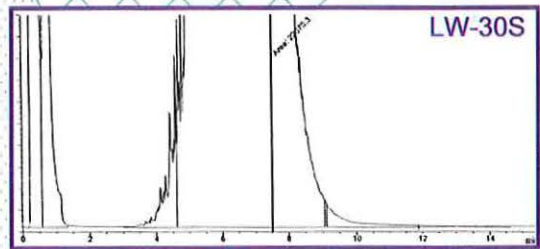
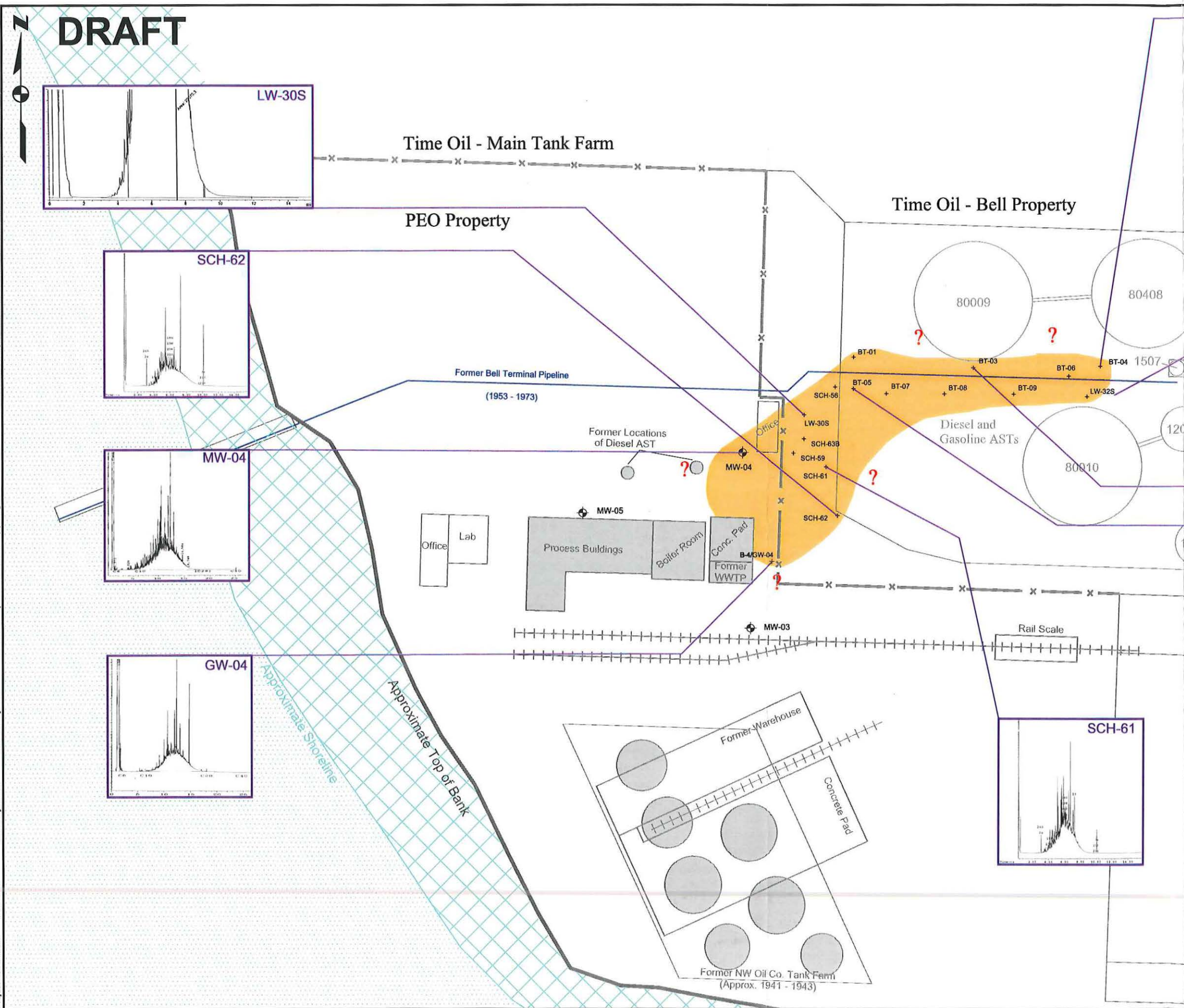
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Product Observation
in Monitoring Wells

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE
3.9

Date: 06/10/2009



LEGEND

- Existing Structure
- Former Structure
- Approximate area of tidal and/or seasonal water level fluctuations

NOTES:

1) All site features and locations are approximate.

2)* At this location, both a shallow and deep monitoring well were installed. The capillary fringe zone soil sample was collected while installing the deep monitoring well (LW-32D).

0 50 100 Feet

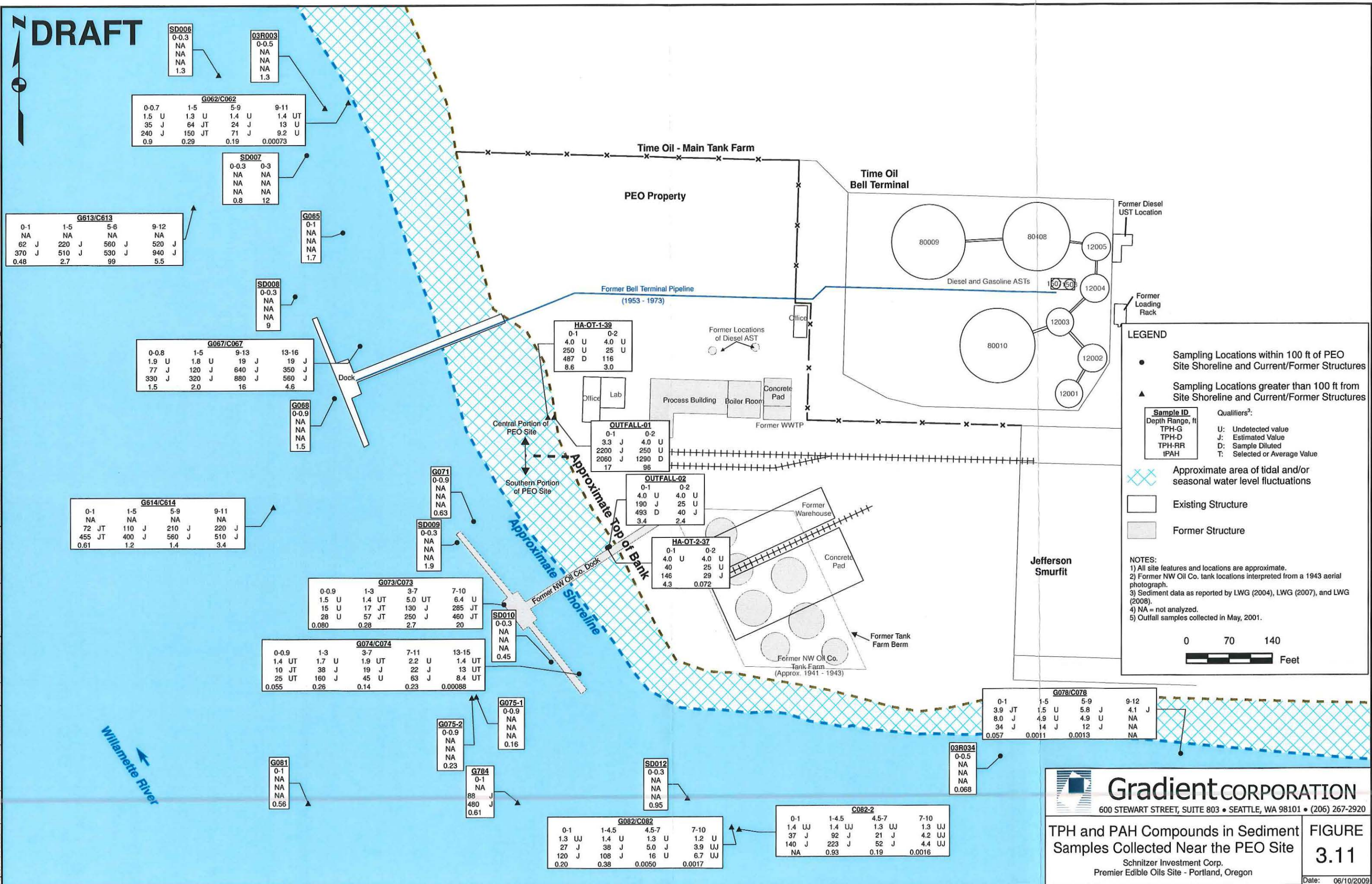
Gradient CORPORATION
600 STEWART STREET, SUITE 803 • SEATTLE, WA 98101 • (206) 267-2920

**Comparison of Chromatograms
Illustrating Diesel Composition for
the Bell Terminal and PEO Properties**

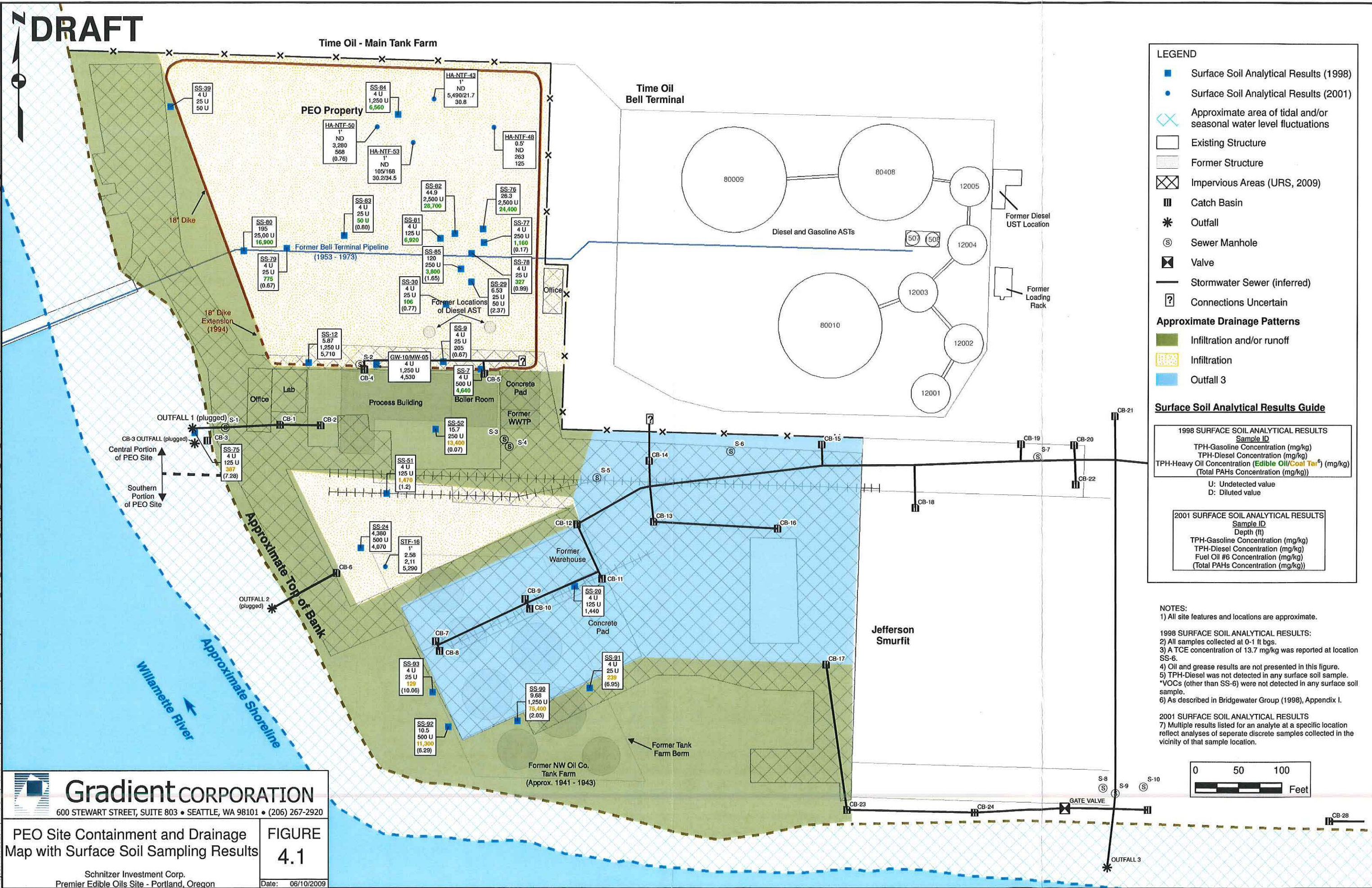
Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE 3.10

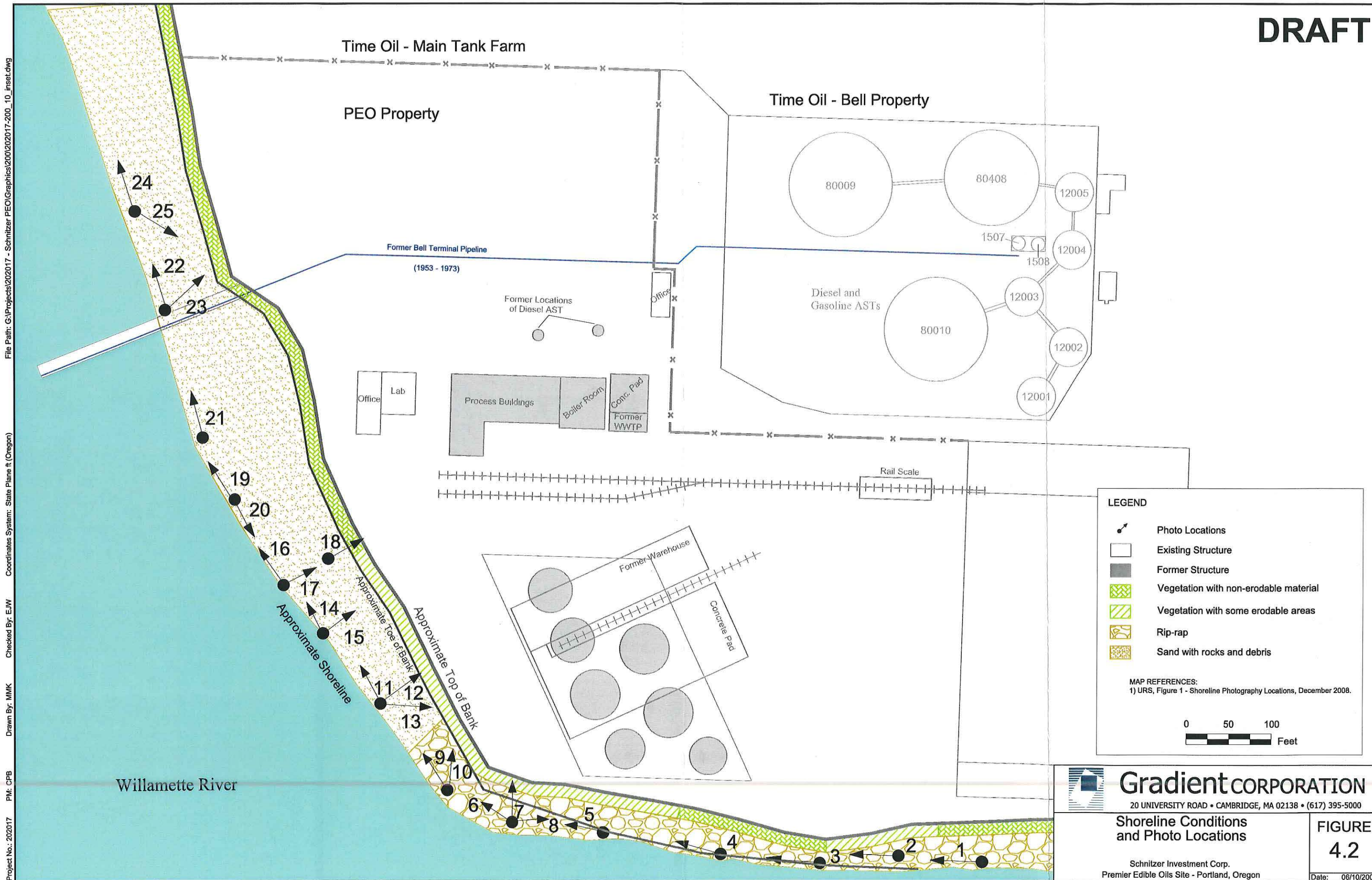
Date: 01/05/2009



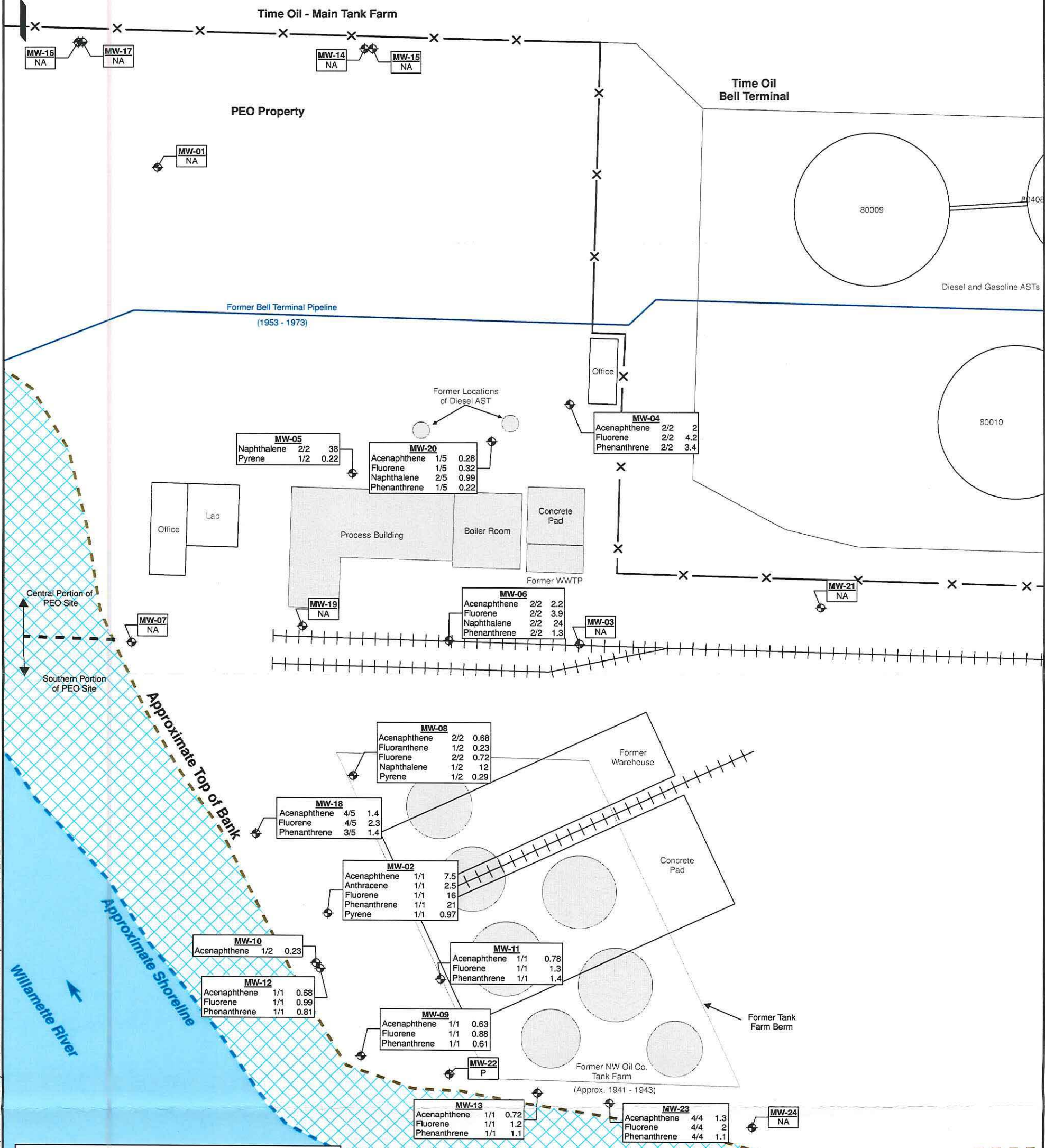
Project No.: 202017; PM: CFB; Author: MMK; Checked By: E.J.W.; Coordinate System: NAD 1983 StatePlane Oregon North FIPS 3601 Feet File Path: G:\Projects\202017 - Schnitzer PEO\Graphics\300\202017-300_12_SSdata.mxd



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LEGEND

Monitoring Well Location

Analyte Sample ID
of Concs. > SLV / # of Samples Maximum GW Conc., µg/L

Approximate area of tidal and/or seasonal water level fluctuations

Existing Structure

Former Structure

NOTES:

- 1) All site features and locations are approximate.
- 2) Former NW Oil Co. tank locations interpreted from a 1943 aerial photograph.
- 3) SLV = Screening Level Value
- 4) MCL = Maximum Contaminant Level for protection of drinking water supplies
- 5) NA = No groundwater concentrations were greater than JSCS SLVs.
- 6) P = Well not sampled due to the presence of product.
- 7) Groundwater samples collected between January 2008 and April 2009.

0 40 80
Feet

Analyte	ODEQ Specified Initial SLV (µg/L)	Basis for SLV
Acenaphthene	0.2	Benzo(a)pyrene MCL
Anthracene	0.2	Benzo(a)pyrene MCL
Fluoranthene	0.2	Benzo(a)pyrene MCL
Fluorene	0.2	Benzo(a)pyrene MCL
Naphthalene	0.2	Benzo(a)pyrene MCL
Phenanthrene	0.2	Benzo(a)pyrene MCL
Pyrene	0.2	Benzo(a)pyrene MCL



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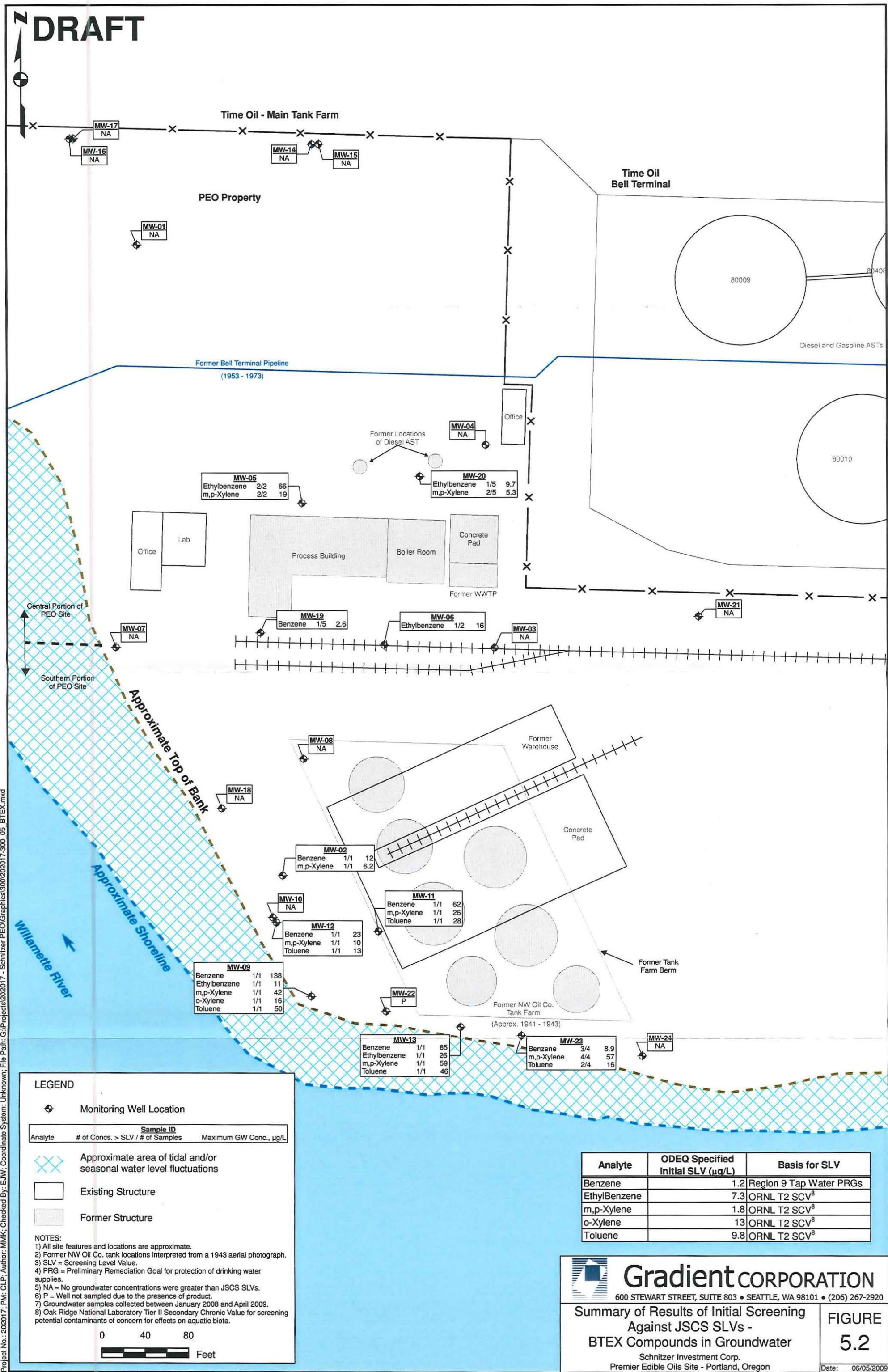
Summary of Results of Initial Screening
Against JSCS SLVs -
PAH Compounds in Groundwater

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE
5.1

Date: 06/05/2009

DRAFT



Project No.: 202017; PM: CLP; Author: MMK; Checked By: EJW; Coordinate System: Unknown; File Path: G:\Projects\202017 - Schnitzer PEO\Graphics\300\202017-300_05_BTTEX.mxd

LEGEND

Sample ID		
Analyte	# of Concs. > SLV / # of Samples	Maximum GW Conc., µg/L
Monitoring Well Location		
Approximate area of tidal and/or seasonal water level fluctuations		
Existing Structure		
Former Structure		

NOTES:
1) All site features and locations are approximate.
2) Former NW Oil Co. tank locations interpreted from a 1943 aerial photograph.
3) SLV = Screening Level Value.
4) PRG = Preliminary Remediation Goal for protection of drinking water supplies.
5) NA = No groundwater concentrations were greater than JSCS SLVs.
6) P = Well not sampled due to the presence of product.
7) Groundwater samples collected between January 2008 and April 2009.
8) Oak Ridge National Laboratory Tier II Secondary Chronic Value for screening potential contaminants of concern for effects on aquatic biota.

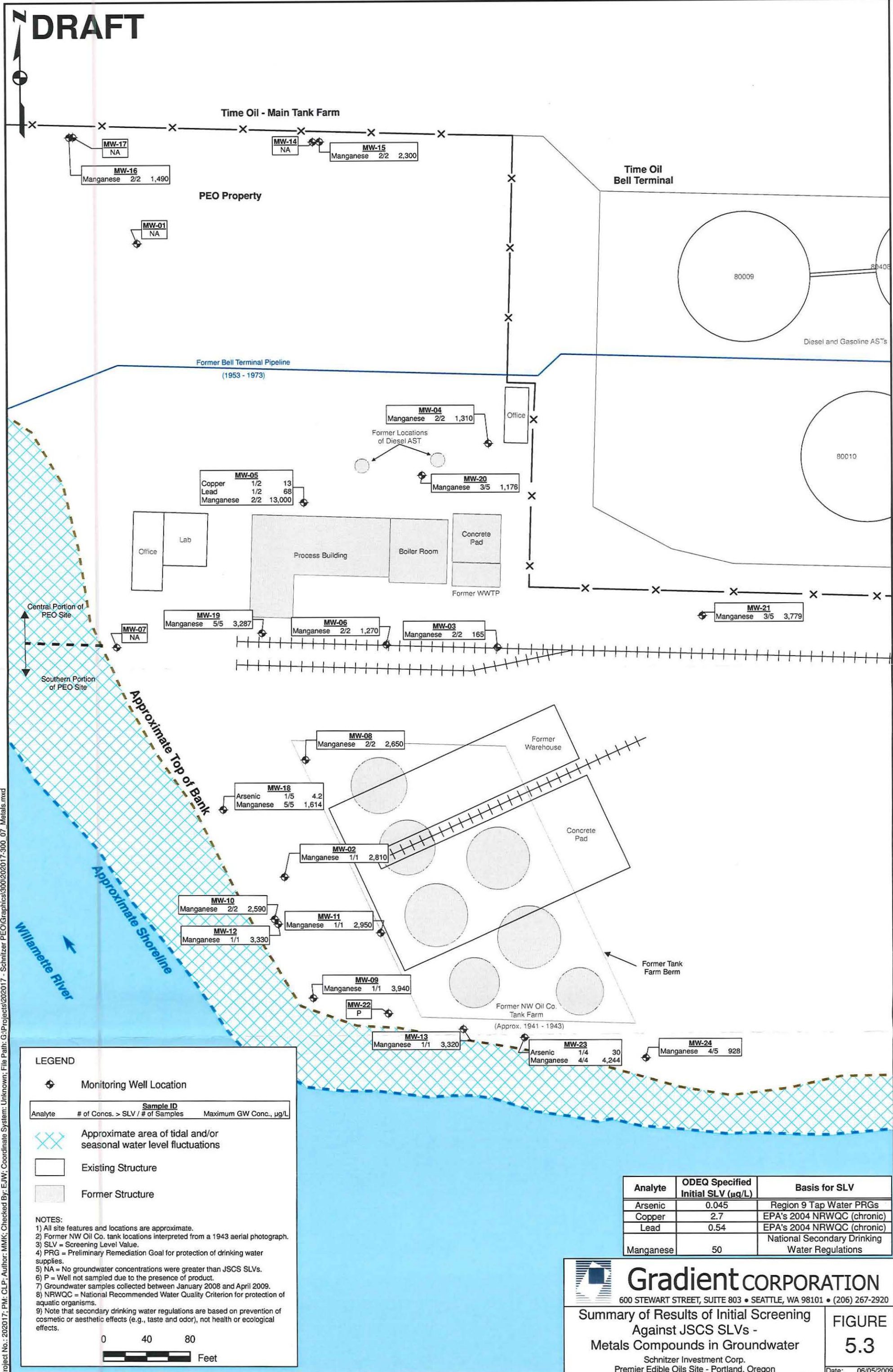
0 40 80
Feet

Analyte	ODEQ Specified Initial SLV (µg/L)	Basis for SLV
Benzene	1.2	Region 9 Tap Water PRGs
EthylBenzene	7.3	ORNL T2 SCV ⁸
m,p-Xylene	1.8	ORNL T2 SCV ⁸
o-Xylene	13	ORNL T2 SCV ⁸
Toluene	9.8	ORNL T2 SCV ⁸

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Summary of Results of Initial Screening
Against JSCS SLVs -
BTEX Compounds in Groundwater
Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE 5.2
Date: 06/05/2009

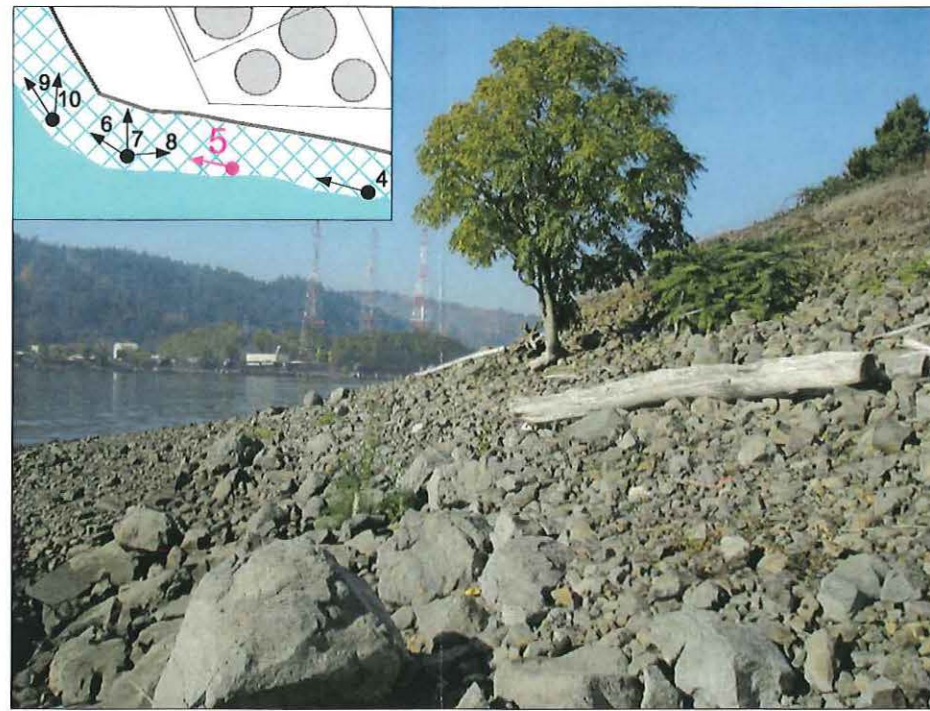
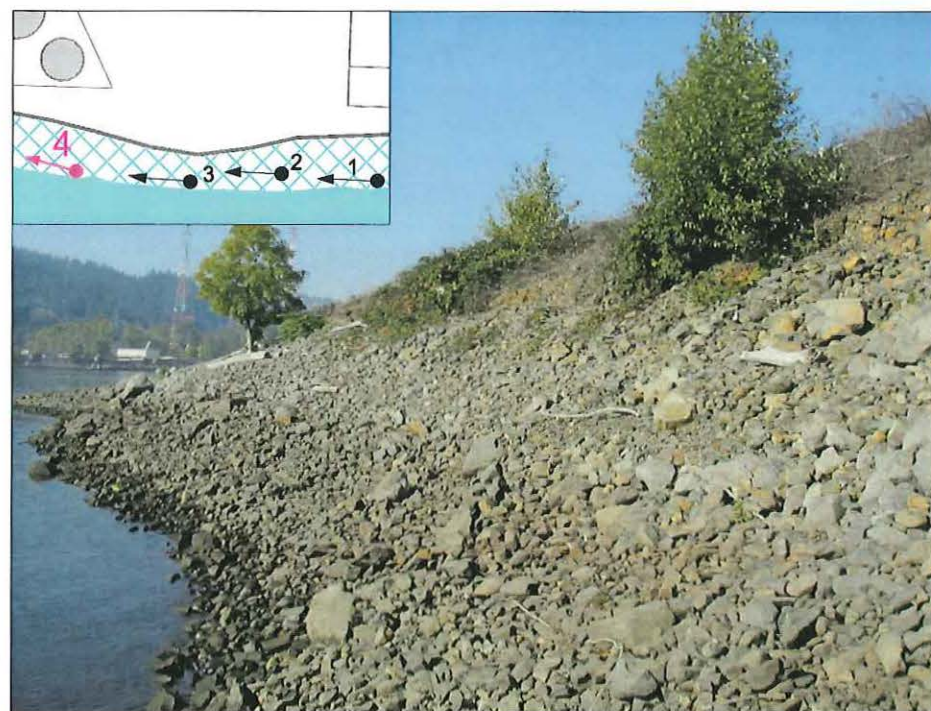
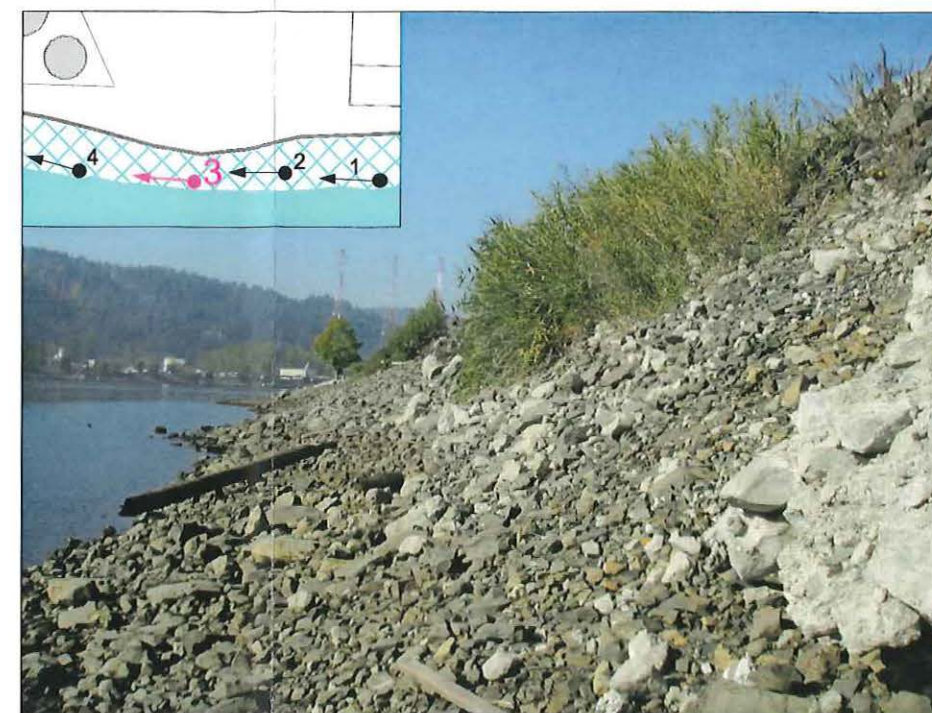
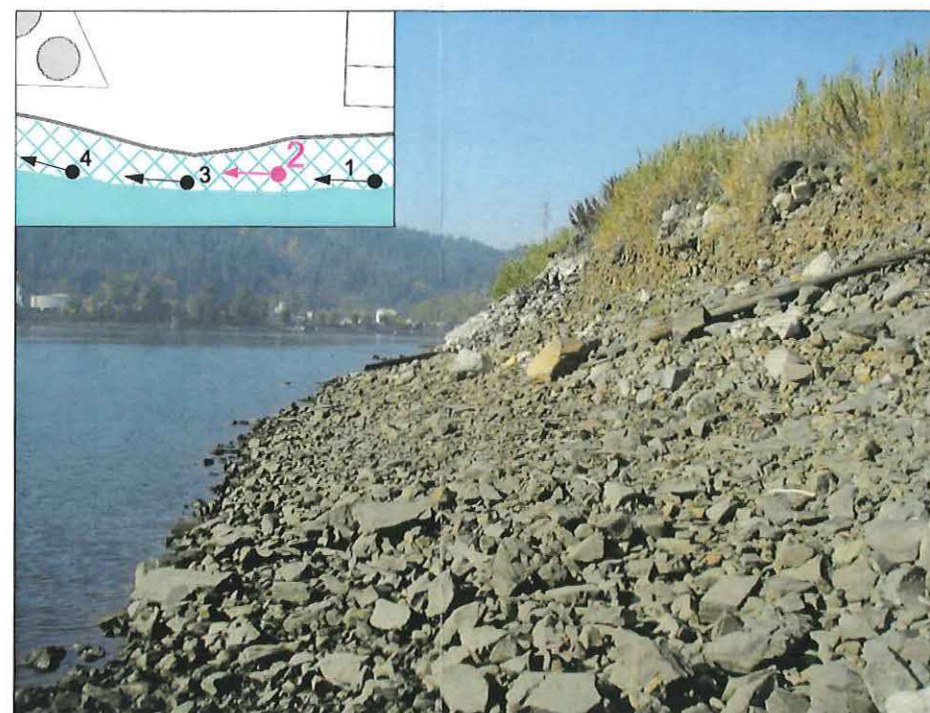
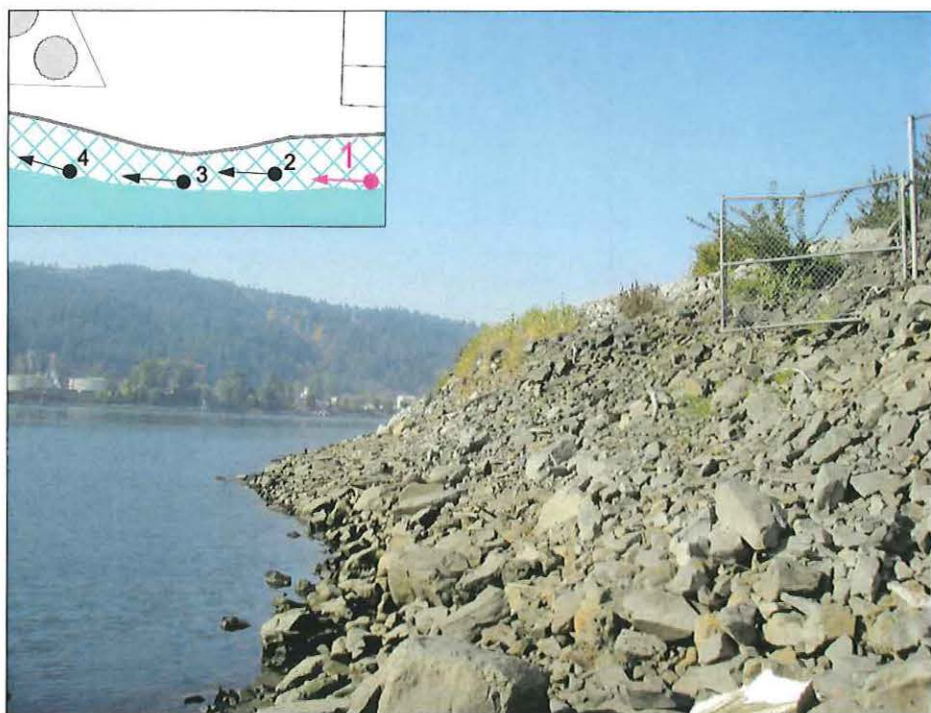


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Appendix A

Bank Photos

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MAP REFERENCES:
1) URS, Figure 1 - Shoreline Photography Locations, December 2008.



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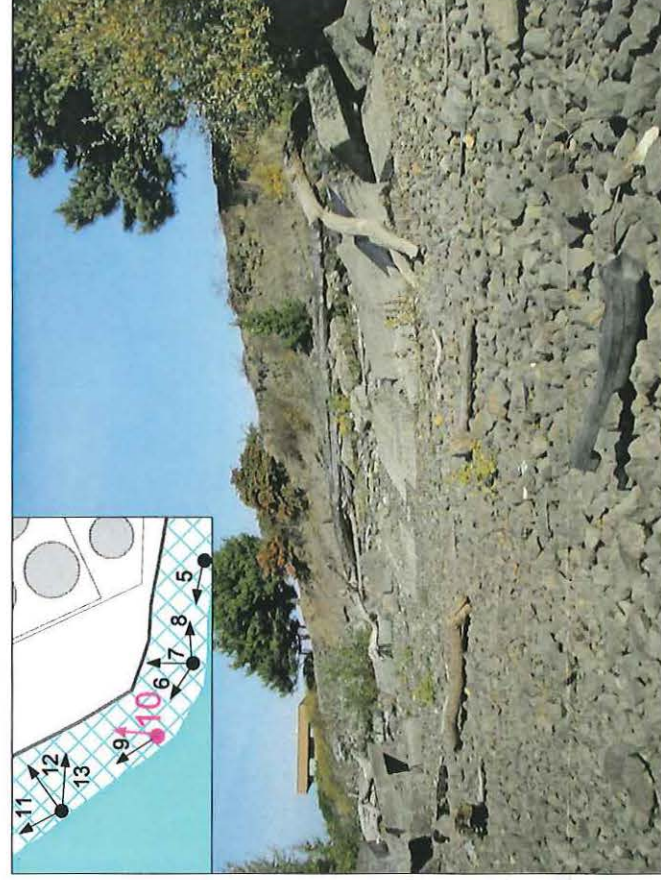
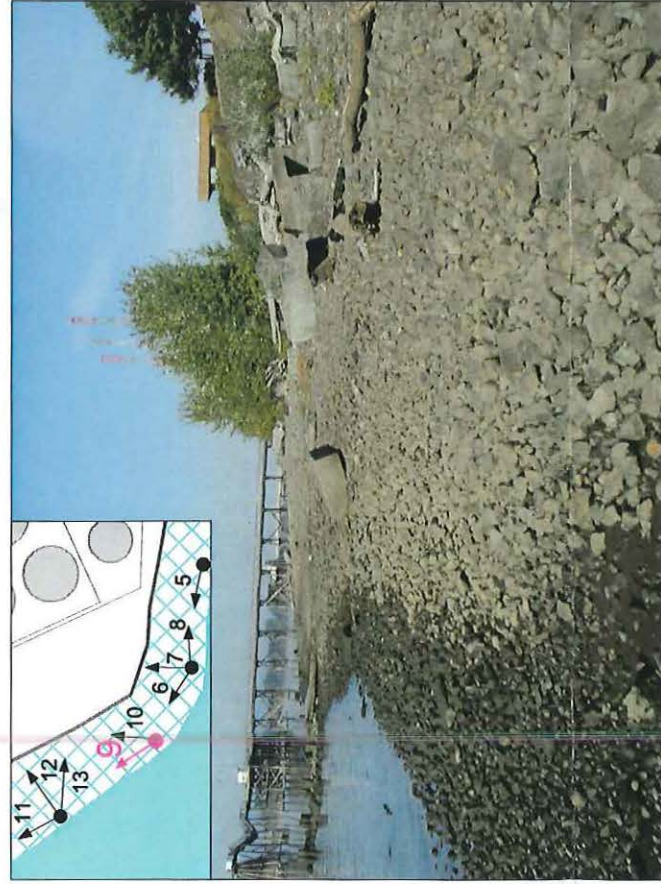
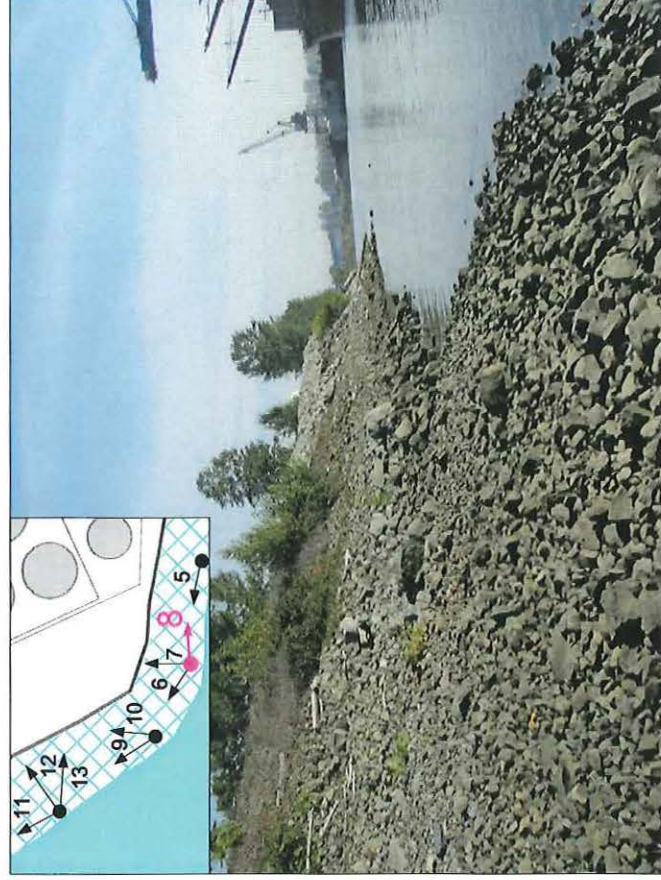
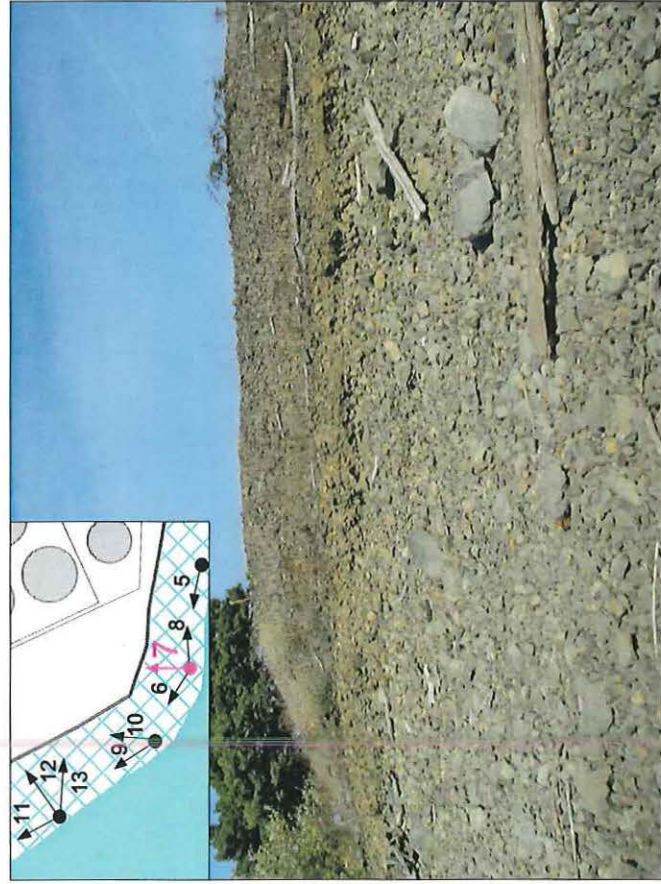
Bank Photos

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE
A.1a

Date: 06/11/2009

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MAP REFERENCES:
1) URS, Figure 1 - Shoreline Photography Locations, December 2008.



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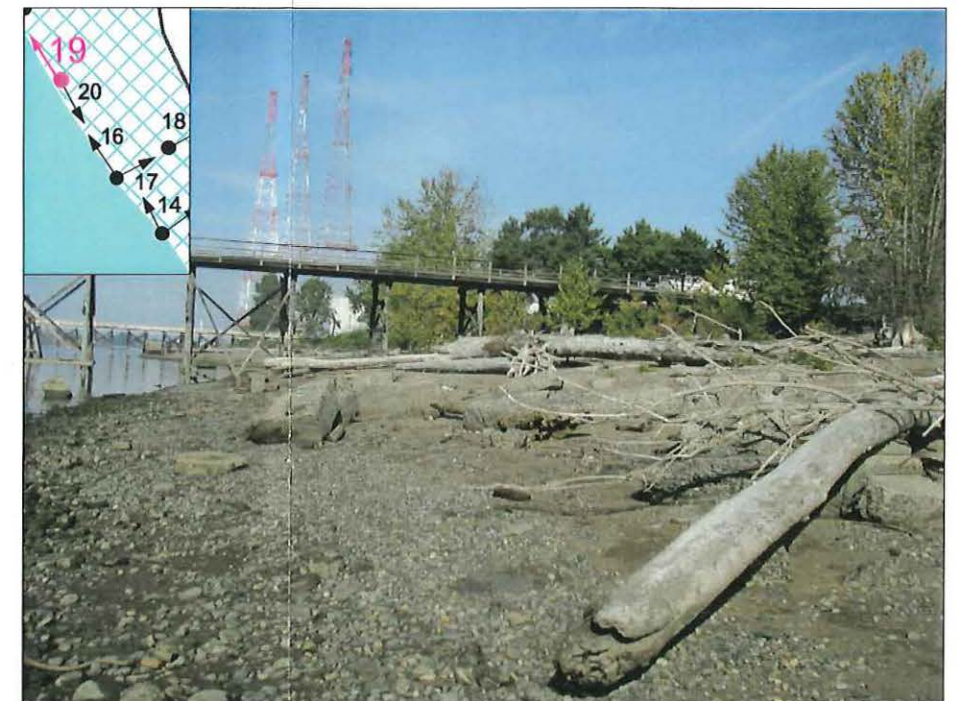
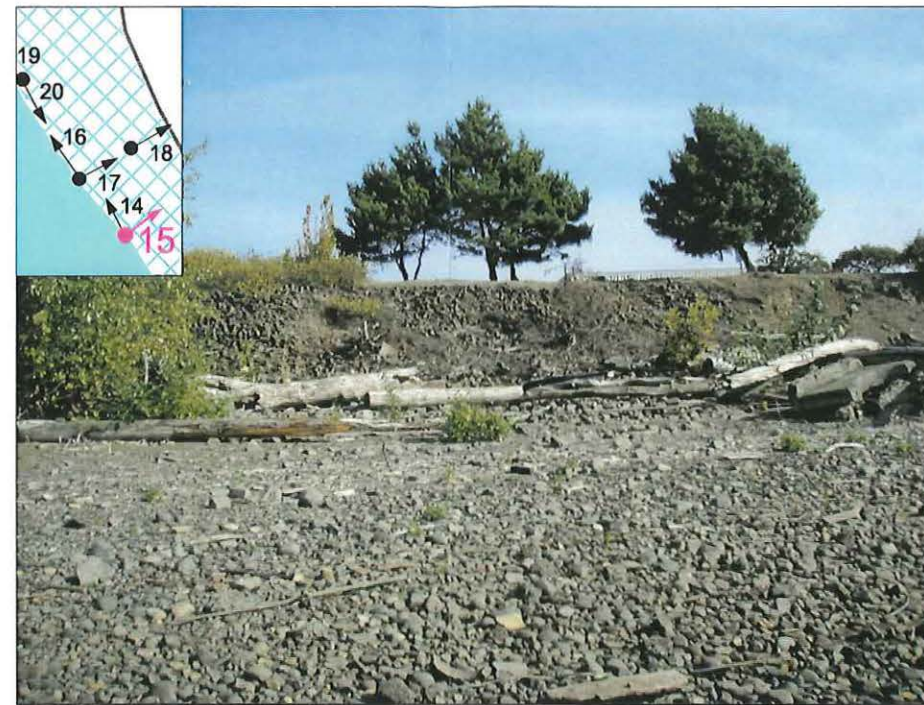
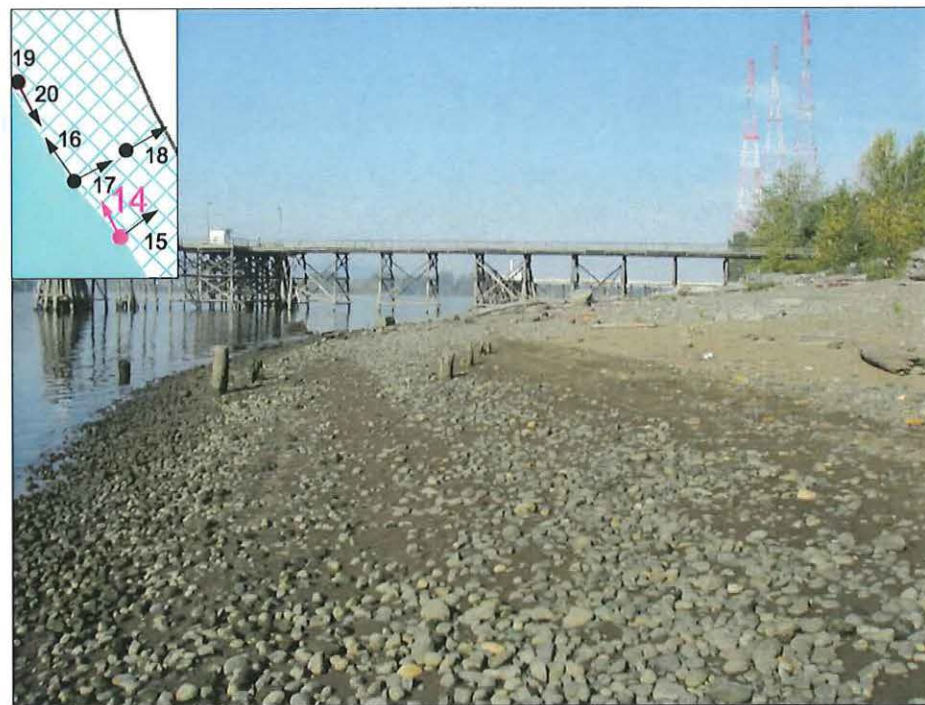
Bank Photos

Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

FIGURE
A.1b

Date: 08/17/2009

DRAFT



MAP REFERENCES:
1) URS, Figure 1 - Shoreline Photography Locations, December 2008.



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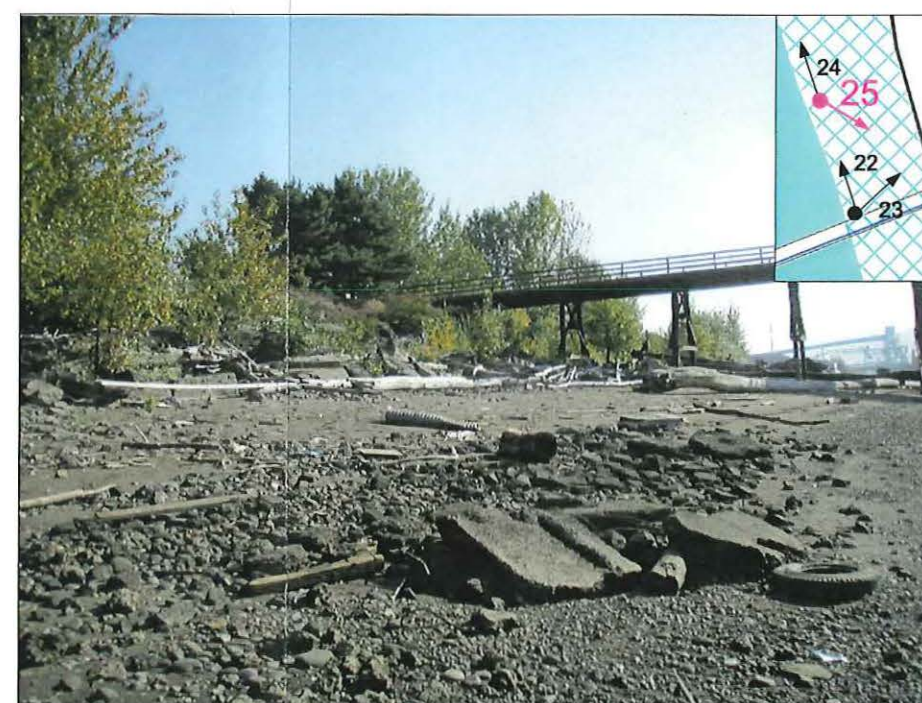
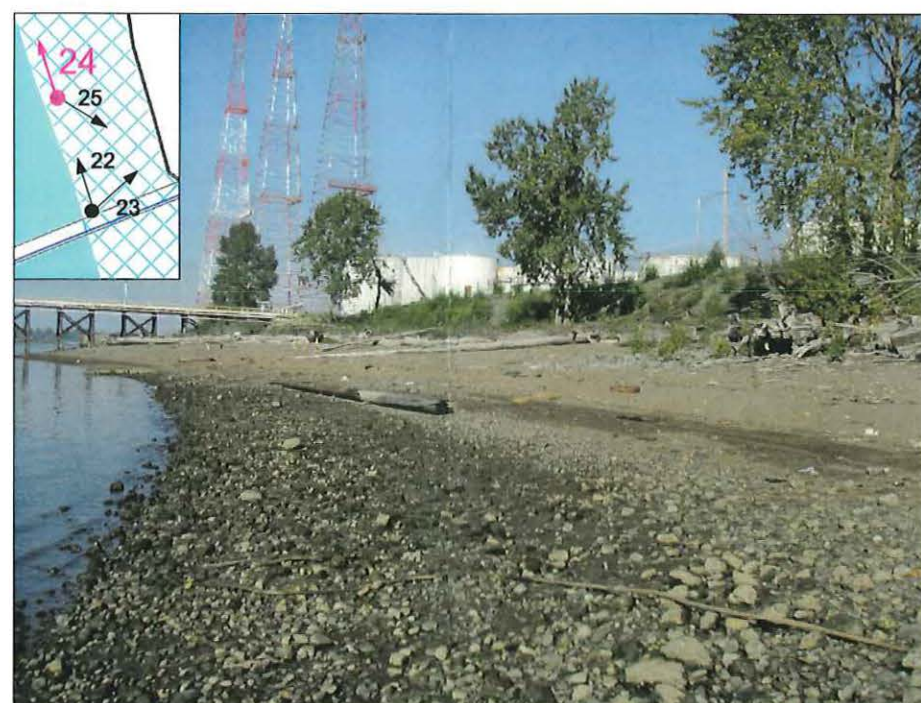
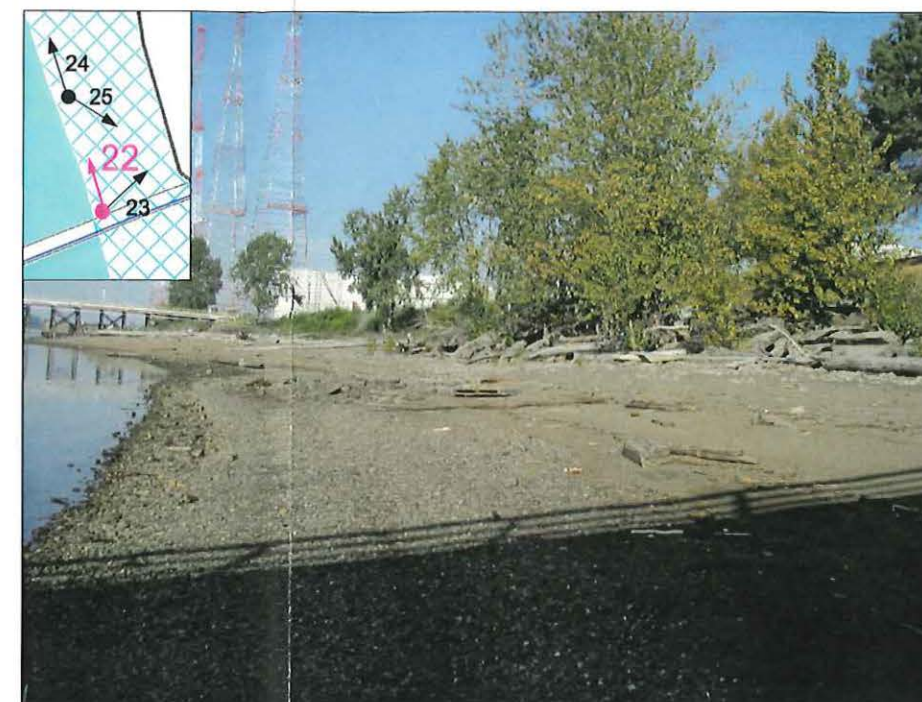
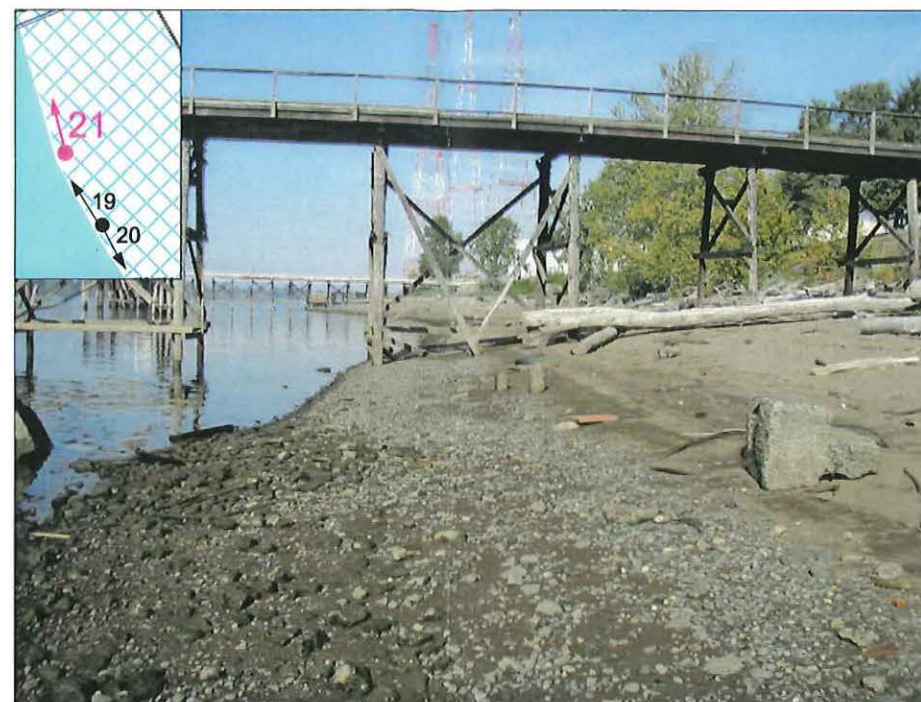
Schnitzer Investment Corp.
Premier Edible Oils Site - Portland, Oregon

**FIGURE
A.1c**

Date: 06/11/2009

Project No.: 202017 PM: CPB Drawn By: MMK Checked By: E.W Coordinates System: State Plane ft (Oregon) File Path: G:\Projects\202017 - Schnitzer PEO\Graphics\200\202017-200_09_photos20-25.dwg

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MAP REFERENCES:
1) URS, Figure 1 - Shoreline Photography Locations, December 2008.

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FIGURE
A.1d

Date: 06/11/2009

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Appendix B

Migration Calculation

**Table B.1. LNAPL Migration Velocity Calculation
Southern PEO Site**

Parameter	Symbol	units (both)	Gradient	Low Gradient	High Notes
Hydraulic Conductivity (Water)	K_{Water}	cm/s	1.0E-03	1.0E-02	Assume silty sand to silt, loess (Domenico & Schwartz, 1998; Freeze & Cherry, 1979);
Intrinsic Permeability	k	cm ²	1.0E-08	1.0E-07	Calculated
LNAPL Density	ρ_{LNAPL}	g/cm ³	0.846	0.846	From MW-02
Gravitational acceleration	g	cm/s ²	982	982	Constant
Kinematic Viscosity (LNAPL)	ν_{LNAPL}	cm ² /s	2.38E-02	2.38E-02	From MW-02
Dynamic viscosity (water)	μ_{Water}	g/cm*s	0.01	0.01	Roberson & Crowe, 1997 @ 10°C
Dynamic viscosity (LNAPL)	μ_{LNAPL}	g/cm*s	0.02	0.02	Calculated
Hydraulic Conductivity (LNAPL)	K_{LNAPL}	cm/s	4.2E-04	4.2E-03	Calculated
Lateral Gradient	∇H	[-]	0.0100	0.0200	Transport following water table, e.g. Figure 2.11
Porosity, effective	n_e	[-]	0.30	0.30	medium sand, Domenico and Schwartz, 1998
LNAPL Velocity	q_{LNAPL}	cm/s	1E-05	3E-04	Calculated
LNAPL Velocity	q_{LNAPL}	m/yr	4.4	88.3	Calculated
Migration Distance (t=60 yrs)		m	265	5300	
Approximate distance to river (PB-09)		m	88	88	From PB-09 to approx. shoreline
Time (yrs) to reach river (PB-09)		yrs	20	1	

Notes: 1) Calculation based on Darcy's Law.

2) Calculation does not account for surface tension / pore pressure.

Equations:

$$Eq. 1: q_{LNAPL} = \frac{-K_{LNAPL} \nabla H}{n_e}$$

$$Eq. 2a: K_{LNAPL} = \frac{k \rho_{LNAPL} g}{\mu_{LNAPL}}$$

$$Eq. 2b: K_{Water} = \frac{k \rho_{Water} g}{\mu_{Water}}$$

$$Eq. 3: \mu_{LNAPL} = \nu_{LNAPL} \rho_{LNAPL}$$

$$Eq. 4: \nabla H = \frac{\Delta Z}{\Delta X}$$

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Appendix C

Site Data Screening Using JSCS Screening Level Values (SLVs)

Table C.1. Comparison of Central PEO Site Groundwater Data Against JSCS SLVs

		JSCS Table 3-1,	MW-01 2/24/2009	MW-03 1/7/2009	MW-03 2/23/2009	MW-04 1/6/2009	MW-04 2/26/2009	MW-05 1/6/2009	MW-05 2/25/2009	MW-06 1/7/2009	MW-06 [DUP] 1/7/2009	MW-06 2/24/2009	MW-07 1/7/2009	MW-07 2/25/2009	MW-14 1/7/2009	MW-14 2/26/2009	MW-15 1/7/2009
Metals																	
Chromium	mg/l	0.1	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Copper	mg/l	0.0027	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.013	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Iron	mg/l	--	0.10 U	0.38	0.38	45	28	31	15	50	51	44	0.10 U	0.10 U	0.13	0.56	1.5
Lead	mg/l	0.00054	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.068	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Manganese	mg/l	0.05	0.050 U	0.17	0.053	1.3	1.2	13	13	1.3	1.3	1.2	0.050 U	0.050 U	0.050 U	0.050 U	2.3
Nickel	mg/l	0.016	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Arsenic	mg/l	0.000045	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Silver	mg/l	0.00012	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U
Zinc	mg/l	0.036	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U
8260B																	
Acetone	ug/l	1500	25 U	25 U	25 U	25 U	25 U	25 U	125 U	125 U	125 U	250 U	25 U	25 U	25 U	25 U	25 U
sec-Butylbenzene	ug/l	--	1.0 U	1.0 U	1.0 U	6.5	6.4	1.0 U	5.0 U	30	32	42	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
tert-Butylbenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon disulfide	ug/l	0.92	10 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	50 U	100 U	10 U	10 U	10 U	10 U	10 U
Carbon tetrachloride	ug/l	0.51	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	ug/l	50	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	ug/l	23	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	ug/l	0.17	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	ug/l	2.1	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	25 U	25 U	25 U	50 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Chlorotoluene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
4-Chlorotoluene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Benzene	ug/l	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	ug/l	--	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	25 U	25 U	25 U	50 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Dibromochloromethane	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	ug/l	0.033	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Dibromomethane	ug/l	61	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	ug/l	49	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	ug/l	14	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	ug/l	2.8	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Dichlorodifluoromethane	ug/l	390	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	25 U	25 U	25 U	50 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethane	ug/l	47	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	ug/l	0.73	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromobenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	ug/l	61	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	ug/l	110	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloropropane	ug/l	0.97	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichloropropane	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2,2-Dichloropropane	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloropropene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	ug/l	0.055	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	ug/l	0.055	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	ug/l	7.3	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	18	66	14	16	10 U	1.1	1.0 U	1.0 U	1.0 U
Bromochloromethane	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Hexachlorobutadiene	ug/l	0.86	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	20 U	20 U	20 U	40 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U
2-Hexanone	ug/l	99	10 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	50 U	100 U	10 U	10 U	10 U	10 U	10 U
Isopropylbenzene	ug/l	660	2.0 U	2.0 U	2.0 U	7.2	7.1	6.5	13	35	39	37	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
p-Isopropyltoluene	ug/l	--	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	10 U	10 U	10 U	20 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
4-Methyl-2-pentanone	ug/l	170	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	25 U	25 U	25 U	50 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Methyl tert-butyl ether	ug/l	37	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Methylene chloride	ug/l	8.9	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	25 U	25 U	25 U	50 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U

Table C.1. Comparison of Central PEO Site Groundwater Data Against JSCS SLVs

		JSCS Table 3-1,	MW-01 2/24/2009	MW-03 1/7/2009	MW-03 2/23/2009	MW-04 1/6/2009	MW-04 2/26/2009	MW-05 1/6/2009	MW-05 2/25/2009	MW-06 1/7/2009	MW-06 [DUP] 1/7/2009	MW-06 2/24/2009	MW-07 1/7/2009	MW-07 2/25/2009	MW-14 1/7/2009	MW-14 2/26/2009	MW-15 1/7/2009
Naphthalene	ug/l	0.2	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	3.3	38	21	24	20 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
n-Propylbenzene	ug/l	--	1.0 U	1.0 U	1.0 U	29	32	9.2	23	139	152	209	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	ug/l	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	ug/l	1.1	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,1,2-Tetrachloroethane	ug/l	2.5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	ug/l	0.33	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	ug/l	0.12	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Toluene	ug/l	9.8	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2,3-Trichlorobenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2,4-Trichlorobenzene	ug/l	8.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,1-Trichloroethane	ug/l	11	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	ug/l	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	ug/l	0.17	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichlorofluoromethane	ug/l	1300	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	ug/l	8.5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2,3-Trichloropropane	ug/l	0.0095	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2,4-Trimethylbenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	160	118	9.7	11	83	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3,5-Trimethylbenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	106	64	25	29	35	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl chloride	ug/l	0.015	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
o-Xylene	ug/l	13	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
m,p-Xylene	ug/l	1.8	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	15	19	10 U	10 U	20 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Bromomethane	ug/l	8.7	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	25 U	25 U	25 U	50 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Butanone (MEK)	ug/l	7100	10 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	50 U	100 U	10 U	10 U	10 U	10 U	10 U
n-Butylbenzene	ug/l	--	5.0 U	5.0 U	5.0 U	10	9.7	13	25 U	63	65	95	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
8270 SIM																	
Acenaphthene	ug/l	0.2	0.095 U	0.095 U	0.096 U	2.0	1.4	0.095 U	0.095 U	1.1	1.1	2.2	0.095 U	0.096 U		R 0.095 U	0.095 U
Dibenzo (a,h) anthracene	ug/l	0.018	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.39 U	0.19 U	0.19 U		R 0.19 U	0.19 U
Fluoranthene	ug/l	0.2	0.095 U	0.095 U	0.096 U	0.095 U	0.096 U	0.095 U	0.095 U	0.097 U	0.097 U	0.19 U	0.095 U	0.096 U		R 0.095 U	0.095 U
Fluorene	ug/l	0.2	0.095 U	0.095 U	0.096 U	4.2	2.4	0.095 U	0.095 U	2.0	2.0	3.9	0.095 U	0.096 U		R 0.095 U	0.095 U
Indeno (1,2,3-cd) pyrene	ug/l	0.018	0.095 U	0.095 U	0.096 U	0.095 U	0.096 U	0.095 U	0.095 U	0.097 U	0.097 U	0.19 U	0.095 U	0.096 U		R 0.095 U	0.095 U
Naphthalene (SIM)	ug/l	0.2	0.095 U	0.095 U	0.096 U	0.71 U	0.43 U	0.14 U	28	11	10.0	13	0.095 U	0.096 U		R 0.095 U	0.095 U
Phenanthrene	ug/l	0.2	0.095 U	0.095 U	0.096 U	3.4	0.86	0.095 U	0.095 U	0.45	0.50	1.3	0.095 U	0.096 U		R 0.095 U	0.095 U
Pyrene	ug/l	0.2	0.095 U	0.095 U	0.096 U	0.095 U	0.096 U	0.12	0.22	0.097 U	0.097 U	0.19 U	0.095 U	0.096 U		R 0.095 U	0.095 U
Acenaphthylene	ug/l	0.2	0.095 U	0.095 U	0.096 U	0.57 U	0.29 U	0.095 U	0.095 U	0.29 U	0.29 U	0.58 U	0.095 U	0.096 U		R 0.095 U	0.095 U
Anthracene	ug/l	0.2	0.095 U	0.095 U	0.096 U	0.17	0.14 U	0.095 U	0.095 U	0.097 U	0.097 U	0.19 U	0.095 U	0.096 U		R 0.095 U	0.095 U
Benzo (a) anthracene	ug/l	0.018	0.095 U	0.095 U	0.096 U	0.095 U	0.096 U	0.095 U	0.095 U	0.097 U	0.097 U	0.19 U	0.095 U	0.096 U		R 0.095 U	0.095 U
Benzo (a) pyrene	ug/l	0.018	0.095 U	0.095 U	0.096 U	0.095 U	0.096 U	0.095 U	0.095 U	0.097 U	0.097 U	0.19 U	0.095 U	0.096 U		R 0.095 U	0.095 U
Benzo (b) fluoranthene	ug/l	0.018	0.095 U	0.095 U	0.096 U	0.095 U	0.096 U	0.095 U	0.095 U	0.097 U	0.097 U	0.19 U	0.095 U	0.096 U		R 0.095 U	0.095 U
Benzo (ghi) perylene	ug/l	0.2	0.095 U	0.095 U	0.096 U	0.095 U	0.096 U	0.095 U	0.095 U	0.097 U	0.097 U	0.19 U	0.095 U	0.096 U		R 0.095 U	0.095 U
Benzo (k) fluoranthene	ug/l	0.018	0.095 U	0.095 U	0.096 U	0.095 U	0.096 U	0.095 U	0.095 U	0.097 U	0.097 U	0.19 U	0.095 U	0.096 U		R 0.095 U	0.095 U
Chrysene	ug/l	0.018	0.095 U	0.095 U	0.096 U	0.095 U	0.096 U	0.095 U	0.095 U	0.097 U	0.097 U	0.19 U	0.095 U	0.096 U		R 0.095 U	0.095 U
TPH																	
Gasoline Range Hydrocarbons (Gx)	ug/l	--	80 U	80 U	80 U	654	766	2240	2530	3290	3240	4440	80 U	80 U	80 U	80 U	80 U
Diesel Range Organics	mg/l	--	0.24 U	0.29	0.25 U	5.9	5.0	4.9	3.1	4.0	3.8	6.2	0.50	0.24 U	0.24 U	0.24 U	0.24 U
Heavy Oil Range Hydrocarbons (Dx)	mg/l	--	0.48 U	0.48 U	0.50 U	0.48 U	0.49 U	0.48 U	0.49 U	0.48 U	0.48 U	0.50 U	0.48 U	0.47 U	0.48 U	0.47 U	0.48 U

Notes: U: Analyte Not Detected at or above the reporting limit. Values shown are Method Reporting Limit.
J: Estimated
Values in bold are above specified JSCS SLV.

Table C.1. Comparison of Central PEO Site Groundwater Data Against JSCS SLVs

		JSCS Table 3-1,	MW-15 2/26/2009	MW-16 1/6/2009	MW-16 2/26/2009	MW-17 1/6/2009	MW-17 2/26/2009	MW-19 2/17/2008	MW-19 [DUP] 2/17/2008	MW-19 6/2/2008	MW-19 [DUP] 6/2/2008	MW-19 8/25/2008	MW-19 [DUP] 8/25/2008	MW-19 11/21/2008
Metals														
Chromium	mg/l	0.1	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Copper	mg/l	0.0027	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Iron	mg/l	--	0.78	11	11	0.10 U	0.10 U	0.31 J	0.43 J	11	11	0.22	0.21	0.12
Lead	mg/l	0.00054	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 UJ	0.050 UJ	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Manganese	mg/l	0.05	1.9	1.5	1.2	0.050 U	0.050 U	0.54 J	0.60 J	3.3	3.3	0.63	0.61	3.29
Nickel	mg/l	0.016	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 UJ	0.050 UJ	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Arsenic	mg/l	0.000045	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 UJ	0.050 UJ	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Silver	mg/l	0.00012	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 UJ	0.020 UJ	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U
Zinc	mg/l	0.036	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 UJ	0.020 UJ	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U
8260B														
Acetone	ug/l	1500	25 U	25 U	25 U	25 U	25 U	25 UJ	25 UJ	25 U	25 U	25 U	25 U	25 U
sec-Butylbenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
tert-Butylbenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon disulfide	ug/l	0.92	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U
Carbon tetrachloride	ug/l	0.51	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	ug/l	50	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	ug/l	23	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	ug/l	0.17	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	ug/l	2.1	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Chlorotoluene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
4-Chlorotoluene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Benzene	ug/l	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	2.4
1,2-Dibromo-3-chloropropane	ug/l	--	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Dibromochloromethane	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	ug/l	0.033	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Dibromomethane	ug/l	61	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	ug/l	49	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	ug/l	14	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	ug/l	2.8	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Dichlorodifluoromethane	ug/l	390	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethane	ug/l	47	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	ug/l	0.73	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromobenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	ug/l	61	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	ug/l	110	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloropropane	ug/l	0.97	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichloropropane	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2,2-Dichloropropane	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloropropene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	ug/l	0.055	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	ug/l	0.055	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	ug/l	7.3	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Hexachlorobutadiene	ug/l	0.86	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 UJ	4.0 UJ	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U
2-Hexanone	ug/l	99	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U
Isopropylbenzene	ug/l	660	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 UJ	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
p-Isopropyltoluene	ug/l	--	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 UJ	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
4-Methyl-2-pentanone	ug/l	170	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Methyl tert-butyl ether	ug/l	37	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Methylene chloride	ug/l	8.9	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U

Table C.1. Comparison of Central PEO Site Groundwater Data Against JSCS SLVs

		JSCS Table 3-1,	MW-15 2/26/2009	MW-16 1/6/2009	MW-16 2/26/2009	MW-17 1/6/2009	MW-17 2/26/2009	MW-19 2/17/2008	MW-19 [DUP] 2/17/2008	MW-19 6/2/2008	MW-19 [DUP] 6/2/2008	MW-19 8/25/2008	MW-19 [DUP] 8/25/2008	MW-19 11/21/2008
Naphthalene	ug/l	0.2	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 UJ	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
n-Propylbenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	ug/l	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	ug/l	1.1	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,1,2-Tetrachloroethane	ug/l	2.5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	ug/l	0.33	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	ug/l	0.12	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Toluene	ug/l	9.8	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	2.4 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2,3-Trichlorobenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2,4-Trichlorobenzene	ug/l	8.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,1-Trichloroethane	ug/l	11	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	ug/l	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	ug/l	0.17	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichlorofluoromethane	ug/l	1300	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	ug/l	8.5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2,3-Trichloropropane	ug/l	0.0095	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2,4-Trimethylbenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3,5-Trimethylbenzene	ug/l	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl chloride	ug/l	0.015	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
o-Xylene	ug/l	13	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
m,p-Xylene	ug/l	1.8	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 UJ	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Bromomethane	ug/l	8.7	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Butanone (MEK)	ug/l	7100	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U
n-Butylbenzene	ug/l	--	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
8270 SIM														
Acenaphthene	ug/l	0.2	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.12	0.099	0.098 U	0.097 U	0.147 U
Dibenzo (a,h) anthracene	ug/l	0.018	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 UJ	0.19 UJ	0.19 U	0.19 U	0.20 U	0.19 U	0.20 U
Fluoranthene	ug/l	0.2	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.100 U
Fluorene	ug/l	0.2	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.121 U
Indeno (1,2,3-cd) pyrene	ug/l	0.018	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.100 U
Naphthalene (SIM)	ug/l	0.2	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	2.0 UJ	2.0 UJ	2.0 U	2.0 U	0.098 U	0.097 U	0.100 U
Phenanthrene	ug/l	0.2	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.100 U
Pyrene	ug/l	0.2	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.12	0.11	0.098 U	0.097 U	0.100 U
Acenaphthylene	ug/l	0.2	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.100 U
Anthracene	ug/l	0.2	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.100 U
Benzo (a) anthracene	ug/l	0.018	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.100 U
Benzo (a) pyrene	ug/l	0.018	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.100 U
Benzo (b) fluoranthene	ug/l	0.018	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.100 U
Benzo (ghi) perylene	ug/l	0.2	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.100 U
Benzo (k) fluoranthene	ug/l	0.018	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.100 U
Chrysene	ug/l	0.018	0.095 U	0.095 U	0.095 U	0.095 U	0.095 U	0.095 UJ	0.095 UJ	0.097 U	0.097 U	0.098 U	0.097 U	0.100 U
TPH														
Gasoline Range Hydrocarbons (Gx)	ug/l	--	80 U	80 U	80 U	80 U	80 U	80 UJ	80 UJ	80 U	80 U	80 U	80 U	80 U
Diesel Range Organics	mg/l	--	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 UJ	0.24 UJ	0.43	0.24	0.31	0.29	2.65
Heavy Oil Range Hydrocarbons (Dx)	mg/l	--	0.48 U	0.48 U	0.48 U	0.48 U	0.47 U	0.48 UJ	0.48 UJ	0.48 U	0.48 U	0.49 U	0.49 U	0.48 U

Notes: U: Analyte Not Detected at or above the reporting limit. Values shown are Method Reporting Limit.
J: Estimated
Values in bold are above specified JSCS SLV.

Table C.1. Comparison of Central PEO Site Groundwater Data Against JSCS SLVs

		JSCS Table 3-1,	MW-19 [DUP] 11/21/2008		MW-19 2/24/2009		MW-20 2/17/2008		MW-20 6/2/2008		MW-20 8/25/2008		MW-20 11/22/2008		MW-20 2/26/2009		MW-21 2/17/2008		MW-21 6/2/2008		MW-21 8/25/2008		MW-21 11/21/2008		MW-21 2/23/2009	
Metals																										
Chromium	mg/l	0.1	0.010	U	0.010	U	0.010	UJ	0.010	U	0.010	U	0.010	U	0.010	U	0.010	UJ	0.010	U	0.010	U	0.010	U	0.010	U
Copper	mg/l	0.0027	0.010	U	0.010	U	0.010	UJ	0.010	U	0.010	U	0.010	U	0.010	U	0.010	UJ	0.010	U	0.010	U	0.010	U	0.010	U
Iron	mg/l	--	0.11		0.10	U	1.6	J	11		0.18		19.81		0.10	U	0.61	J	0.27		0.86		1.12		0.14	
Lead	mg/l	0.00054	0.050	U	0.050	U	0.050	UJ	0.050	U	0.050	U	0.050	U	0.050	U	0.050	UJ	0.050	U	0.050	U	0.050	U	0.050	U
Manganese	mg/l	0.05	3.14		0.052		0.15	J	0.72		0.050	U	1.176		0.050	U	0.082	J	0.050	U	3.8		0.1		0.050	U
Nickel	mg/l	0.016	0.050	U	0.050	U	0.050	UJ	0.050	U	0.050	U	0.050	U	0.050	U	0.050	UJ	0.050	U	0.050	U	0.050	U	0.050	U
Arsenic	mg/l	0.000045	0.050	U	0.050	U	0.050	UJ	0.050	U	0.050	U	0.050	U	0.050	U	0.050	UJ	0.050	U	0.050	U	0.050	U	0.050	U
Silver	mg/l	0.00012	0.020	U	0.020	U	0.020	UJ	0.020	U	0.020	U	0.020	U	0.020	U	0.020	UJ	0.020	U	0.020	U	0.020	U	0.020	U
Zinc	mg/l	0.036	0.020	U	0.020	U	0.020	UJ	0.020	U	0.020	U	0.020	U	0.020	U	0.020	UJ	0.020	U	0.020	U	0.020	U	0.020	U
8260B																										
Acetone	ug/l	1500	25	U	25	U	25	UJ	25	U	25	U	25	U	25	U	25	UJ	25	U	25	U	25	U	25	U
sec-Butylbenzene	ug/l	--	1.0	U	1.0	U	1.0	UJ	15		1.0	U	9.0		1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
tert-Butylbenzene	ug/l	--	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Carbon disulfide	ug/l	0.92	10	U	10	U	10	UJ	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	U	10	U
Carbon tetrachloride	ug/l	0.51	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Chlorobenzene	ug/l	50	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Chloroethane	ug/l	23	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Chloroform	ug/l	0.17	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Chloromethane	ug/l	2.1	5.0	U	5.0	U	5.0	UJ	5.0	U	5.0	U	5.0	U	5.0	U	5.0	UJ	5.0	U	5.0	U	5.0	U	5.0	U
2-Chlorotoluene	ug/l	--	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
4-Chlorotoluene	ug/l	--	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Benzene	ug/l	1.2	2.6		1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
1,2-Dibromo-3-chloropropane	ug/l	--	5.0	U	5.0	U	5.0	UJ	5.0	U	5.0	U	5.0	U	5.0	U	5.0	UJ	5.0	U	5.0	U	5.0	U	5.0	U
Dibromochloromethane	ug/l	--	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
1,2-Dibromoethane	ug/l	0.033	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Dibromomethane	ug/l	61	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
1,2-Dichlorobenzene	ug/l	49	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
1,3-Dichlorobenzene	ug/l	14	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
1,4-Dichlorobenzene	ug/l	2.8	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Dichlorodifluoromethane	ug/l	390	5.0	U	5.0	U	5.0	UJ	5.0	U	5.0	U	5.0	U	5.0	U	5.0	UJ	5.0	U	5.0	U	5.0	U	5.0	U
1,1-Dichloroethane	ug/l	47	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
1,2-Dichloroethane	ug/l	0.73	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Bromobenzene	ug/l	--	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
1,1-Dichloroethene	ug/l	--	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
cis-1,2-Dichloroethene	ug/l	61	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
trans-1,2-Dichloroethene	ug/l	110	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
1,2-Dichloropropane	ug/l	0.97	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
1,3-Dichloropropane	ug/l	--	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
2,2-Dichloropropane	ug/l	--	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
1,1-Dichloropropene	ug/l	--	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
cis-1,3-Dichloropropene	ug/l	0.055	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
trans-1,3-Dichloropropene	ug/l	0.055	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Ethylbenzene	ug/l	7.3	1.0	U	1.0	U	1.0	UJ	9.7		1.0	U	4.9		1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Bromochloromethane	ug/l	--	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U
Hexachlorobutadiene	ug/l	0.86	4.0	U	4.0	U	4.0	UJ	4.0	U	4.0	U	4.0	U	4.0	U	4.0	UJ	4.0	U	4.0	U	4.0	U	4.0	U
2-Hexanone	ug/l	99	10	U	10	U	10	UJ	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	U	10	U
Isopropylbenzene	ug/l	660	2.0	U	2.0	U	2.0	UJ	54		2.0	U	53.5		2.0	U	2.0	UJ	2.0	U	2.0	U	2.0	U	2.0	U
p-Isopropyltoluene	ug/l	--	2.0	U	2.0	U	2.0	UJ	2.0	U	2.0	U	2.0	U	2.0	U	2.0	UJ	2.0	U	2.0	U	2.0	U	2.0	U
4-Methyl-2-pentanone	ug/l	170	5.0	U	5.0	U	5.0	UJ	5.0	U	5.0	U	5.0	U	5.0	U	5.0	UJ	5.0	U	5.0	U	5.0	U	5.0	

Table C.1. Comparison of Central PEO Site Groundwater Data Against JSCS SLVs

		JSCS Table 3-1,	MW-19 [DUP] 11/21/2008	MW-19 2/24/2009	MW-20 2/17/2008	MW-20 6/2/2008	MW-20 8/25/2008	MW-20 11/22/2008	MW-20 2/26/2009	MW-21 2/17/2008	MW-21 6/2/2008	MW-21 8/25/2008	MW-21 11/21/2008	MW-21 2/23/2009
Naphthalene	ug/l	0.2	2.0 U	2.0 U	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U
n-Propylbenzene	ug/l	--	1.0 U	1.0 U	1.0 UJ	160	1.0 U	115.1	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	ug/l	100	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	ug/l	1.1	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
1,1,1,2-Tetrachloroethane	ug/l	2.5	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	ug/l	0.33	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	ug/l	0.12	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
Toluene	ug/l	9.8	1.0 U	1.0 U	1.0 UJ	1.2	1.0 U	1.3	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
1,2,3-Trichlorobenzene	ug/l	--	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
1,2,4-Trichlorobenzene	ug/l	8.2	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
1,1,1-Trichloroethane	ug/l	11	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	ug/l	1.2	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	ug/l	0.17	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
Trichlorofluoromethane	ug/l	1300	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	ug/l	8.5	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
1,2,3-Trichloropropane	ug/l	0.0095	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
1,2,4-Trimethylbenzene	ug/l	--	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
1,3,5-Trimethylbenzene	ug/l	--	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.3	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl chloride	ug/l	0.015	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
o-Xylene	ug/l	13	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U
m,p-Xylene	ug/l	1.8	2.0 U	2.0 U	2.0 UJ	5.3	2.0 U	3.4	2.0 U	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U
Bromomethane	ug/l	8.7	5.0 U	5.0 U	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U
2-Butanone (MEK)	ug/l	7100	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U
n-Butylbenzene	ug/l	--	5.0 U	5.0 U	5.0 UJ	26	5.0 U	9.4	5.0 U	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U
8270 SIM														
Acenaphthene	ug/l	0.2	0.111	0.096 U	0.095 UJ	0.28	0.10 U	0.14	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Dibenzo (a,h) anthracene	ug/l	0.018	0.19 U	0.19 U	0.19 UJ	0.19 U	0.20 U	0.19 U	0.20 U	0.19 UJ	0.19 U	0.20 U	0.20 U	0.19 U
Fluoranthene	ug/l	0.2	0.094 U	0.096 U	0.095 UJ	0.097 U	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Fluorene	ug/l	0.2	0.121	0.096 U	0.095 UJ	0.32	0.10 U	0.19	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Indeno (1,2,3-cd) pyrene	ug/l	0.018	0.094 U	0.096 U	0.095 UJ	0.097 U	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Naphthalene (SIM)	ug/l	0.2	0.094 U	0.096 U	2.0 UJ	2.0 U	0.10 U	0.26	0.098 U	2.0 UJ	2.0 U	0.099 U	0.098 U	0.097 U
Phenanthrene	ug/l	0.2	0.094 U	0.096 U	0.095 UJ	0.22	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Pyrene	ug/l	0.2	0.094 U	0.096 U	0.095 UJ	0.097 U	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Acenaphthylene	ug/l	0.2	0.094 U	0.096 U	0.095 UJ	0.097 U	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Anthracene	ug/l	0.2	0.094 U	0.096 U	0.095 UJ	0.097 U	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Benzo (a) anthracene	ug/l	0.018	0.094 U	0.096 U	0.095 UJ	0.097 U	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Benzo (a) pyrene	ug/l	0.018	0.094 U	0.096 U	0.095 UJ	0.097 U	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Benzo (b) fluoranthene	ug/l	0.018	0.094 U	0.096 U	0.095 UJ	0.097 U	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Benzo (ghi) perylene	ug/l	0.2	0.094 U	0.096 U	0.095 UJ	0.097 U	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Benzo (k) fluoranthene	ug/l	0.018	0.094 U	0.096 U	0.095 UJ	0.097 U	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
Chrysene	ug/l	0.018	0.094 U	0.096 U	0.095 UJ	0.097 U	0.10 U	0.09 U	0.098 U	0.095 UJ	0.097 U	0.099 U	0.098 U	0.097 U
TPH														
Gasoline Range Hydrocarbons (Gx)	ug/l	--	80 U	80 U	80 UJ	2530 J	80 U	1417 J	80 U	80 UJ	80 U	80 U	80 U	80 U
Diesel Range Organics	mg/l	--	2.50	0.25 U	0.30 J	0.75	0.25 U	1.34	0.31	0.24 UJ	0.24 U	0.25 U	0.24 U	0.25 U
Heavy Oil Range Hydrocarbons (Dx)	mg/l	--	0.48 U	0.50 U	0.48 UJ	0.48 U	0.49 U	0.48 U	0.49 U	0.48 UJ	0.48 U	0.49 U	0.48 U	0.49 U

Notes: U: Analyte Not Detected at or above the reporting limit. Values shown are Method Reporting Limit.
J: Estimated
Values in bold are above specified JSCS SLV.

Table C.2. Comparison of Southern PEO Site Groundwater Data Against JSCS SLVs

		JSCS Table 3-1, Highlighted													
		MW-02 1/7/2009	MW-08 1/7/2009	MW-08 2/25/2009	MW-08 [DUP] 2/25/2009	MW-09 1/7/2009	MW-10 1/7/2009	MW-10 2/24/2009	MW-11 1/7/2009	MW-12 1/7/2009	MW-13 1/7/2009	MW-18 2/22/2008	MW-18 6/2/2008		
Metals															
Chromium	mg/l	0.1	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010		
Copper	mg/l	0.0027	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010		
Iron	mg/l	—	56	40	42	43	70	27	28	77	68	84	58		
Lead	mg/l	0.00054	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050		
Manganese	mg/l	0.05	2.8	2.7	2.0	2.0	3.9	2.4	2.6	3.0	3.3	1.3	0.057		
Nickel	mg/l	0.016	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050		
Arsenic	mg/l	0.000045	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.0042		
Silver	mg/l	0.000012	0.020	U	0.020	U	0.020	U	0.020	U	0.020	U	0.020		
Zinc	mg/l	0.036	0.020	U	0.020	U	0.020	U	0.020	U	0.020	U	0.020		
8260B															
Acetone	ug/l	1500	50	U	125	U	125	U	125	U	125	U	50		
sec-Butylbenzene	ug/l	—	6.2	U	14	U	12	U	5.0	U	11	U	5.3		
tert-Butylbenzene	ug/l	—	2.0	U	5.0	U	5.0	U	5.0	U	5.0	U	1.0		
Carbon disulfide	ug/l	0.92	20	U	5.0	U	5.0	U	5.0	U	100	U	50		
Carbon tetrachloride	ug/l	0.51	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Chlorobenzene	ug/l	50	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Chloroethane	ug/l	23	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Chloroform	ug/l	0.17	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Chloromethane	ug/l	2.1	10	U	25	U	25	U	25	U	50	U	25		
2-Chlorotoluene	ug/l	—	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
4-Chlorotoluene	ug/l	—	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Benzene	ug/l	1.2	12	5.0	5.0	5.0	5.0	138	5.0	U	10	U	62		
1,2-Dibromo-3-chloropropane	ug/l	—	10	U	25	U	25	U	25	U	50	U	25		
Dibromochloromethane	ug/l	—	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
1,2-Dibromomethane	ug/l	0.033	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Dibromomethane	ug/l	61	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
1,2-Dichlorobenzene	ug/l	49	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
1,3-Dichlorobenzene	ug/l	14	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
1,4-Dichlorobenzene	ug/l	2.8	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Dichlorodifluoromethane	ug/l	390	10	U	25	U	25	U	25	U	50	U	25		
1,1-Dichloroethane	ug/l	47	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
1,2-Dichloroethane	ug/l	0.73	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Bromobenzene	ug/l	—	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
1,1-Dichloroethene	ug/l	—	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
cis-1,2-Dichloroethene	ug/l	61	2.0	U	5.0	U	9.2	U	1.1	U	5.0	U	5.0		
trans-1,2-Dichloroethene	ug/l	110	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
1,2-Dichloropropane	ug/l	0.97	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
1,3-Dichloropropane	ug/l	—	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
2,2-Dichloropropane	ug/l	—	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
1,1-Dichloropropene	ug/l	—	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
cis-1,3-Dichloropropene	ug/l	0.035	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
trans-1,3-Dichloropropene	ug/l	0.055	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Ethylbenzene	ug/l	7.5	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Bromochloromethane	ug/l	—	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Hexachlorobutadiene	ug/l	0.86	8.0	U	20	U	20	U	20	U	40	U	20		
2-Hexanone	ug/l	99	20	U	50	U	50	U	62	U	100	U	50		
Isopropylbenzene	ug/l	660	28	U	43	U	22	U	23	U	36	U	22		
p-Isopropyltoluene	ug/l	—	4.0	U	10	U	10	U	10	U	20	U	10		
4-Methyl-2-pentanol	ug/l	170	10	U	25	U	25	U	25	U	50	U	25		
Methyl tert-butyl ether	ug/l	37	2.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0		
Methylene chloride	ug/l	89	10	U	25	U	25	U	25	U	50	U	25		
Naphthalene	ug/l	0.2	4.0	U	10	U	10	U	12	U	10	U	2.0		

Table C.2. Comparison of Southern PEO Site Groundwater Data Against JSCS SLVs

		JSCS Table 3-1, Highlighted	MW-02 1/7/2009	MW-08 1/7/2009	MW-08 2/25/2009	MW-08 [DUP] 2/25/2009	MW-09 1/7/2009	MW-10 1/7/2009	MW-10 2/24/2009	MW-11 1/7/2009	MW-12 1/7/2009	MW-13 1/7/2009	MW-18 2/22/2008	MW-18 6/2/2008
n-Propylbenzene	ug/l	—	38	113	94	94	23	98	173	52	27	50	16	1.0 U
Styrene	ug/l	100	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
Bromodichloromethane	ug/l	1.1	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
1,1,1,2-Tetrachloroethane	ug/l	2.5	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
1,1,2,2-Tetrachloroethane	ug/l	0.33	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
Tetrachloroethene	ug/l	0.12	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
Toluene	ug/l	9.8	6.7	5.0 U	5.0 U	5.0 U	50	5.0 U	10 U	28	13	46	2.0 U	1.0 U
1,2,3-Trichlorobenzene	ug/l	—	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
1,2,4-Trichlorobenzene	ug/l	8.2	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
1,1,1-Trichloroethane	ug/l	11	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
1,1,2-Trichloroethane	ug/l	1.2	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
Trichloroethene	ug/l	0.17	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
Trichlorofluoromethane	ug/l	1300	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
Bromoform	ug/l	8.5	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
1,2,3-Trichloropropane	ug/l	0.0095	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
1,2,4-Trimethylbenzene	ug/l	—	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	2.0 U	1.0 U
1,3,5-Trimethylbenzene	ug/l	—	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.4	2.7	1.0 U
Vinyl chloride	ug/l	0.015	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U	1.0 U	5.0 U	0.40 U	1.0 U
o-Xylene	ug/l	13	2.0 U	5.0 U	5.0 U	5.0 U	16	5.0 U	10 U	13	3.9	6.9	2.0 U	1.0 U
m,p-Xylene	ug/l	1.8	6.2	10 U	10 U	10 U	42	10 U	20 U	26	10	59	4.0 U	2.0 U
Bromomethane	ug/l	8.7	10 U	25 U	25 U	25 U	25 U	25 U	50 U	25 U	5.0 U	25 U	10 U	5.0 U
2-Butanone (MEK)	ug/l	7100	20 U	50 U	50 U	50 U	50 U	50 U	100 U	50 U	10 U	50 U	20 U	10 U
n-Butylbenzene	ug/l	—	10 U	25 U	25 U	25 U	25 U	25 U	50 U	25 U	5.0 U	25 U	2.0 U	5.0 U
8270 SIM														
Acenaphthene	ug/l	0.2	7.5 J	0.66	0.68	0.60	0.63	0.11	0.33	0.78	0.68	0.72	1.4	0.095 U
Dibenzo (a,h) anthracene	ug/l	0.018	1.9 U	0.19 U	0.19 U	0.19 U	0.19 U	0.20 U	0.19 U	0.20 U	0.20 U	0.19 U	0.19 U	0.19 U
Fluoranthene	ug/l	0.2	0.96 U	0.23	0.11	0.097 U	0.097 U	0.098 U	0.095 U	0.098 U	0.098 U	0.097 U	0.17	0.095 U
Fluorene	ug/l	0.2	16 J	0.66	0.72	0.64	0.88	0.098 U	0.16	1.3	0.99	1.2	2.3	0.095 U
Indeno (1,2,3-cd) pyrene	ug/l	0.018	0.96 U	0.097 U	0.096 U	0.097 U	0.097 U	0.098 U	0.095 U	0.098 U	0.098 U	0.097 U	0.095 U	0.095 U
Naphthalene (SIM)	ug/l	0.2	9.1 U	0.78 U	0.53 U	0.44 U	1.1 U	0.39 U	0.38 U	1.1 U	1.0 U	1.0 U	0.91 U	2.0 U
Phenanthrene	ug/l	0.2	21 J	0.13	0.10	0.097 U	0.61	0.098 U	0.095 U	1.4	0.81	1.1	1.4	0.095 U
Pyrene	ug/l	0.2	0.97 J	0.29	0.15	0.14	0.097 U	0.098 U	0.095 U	0.098 U	0.098 U	0.097 U	0.12	0.095 U
Acenaphthylene	ug/l	0.2	3.4 U	0.15 U	0.14 U	0.15 U	0.15 U	0.098 U	0.095 U	0.20 U	0.15 U	0.19 U	0.38 U	0.095 U
Anthracene	ug/l	0.2	2.5 J	0.097 U	0.096 U	0.097 U	0.097 U	0.098 U	0.095 U	0.098 U	0.098 U	0.097 U	0.12	0.095 U
Benzo (a) anthracene	ug/l	0.018	0.96 U	0.097 U	0.096 U	0.097 U	0.097 U	0.098 U	0.095 U	0.098 U	0.098 U	0.097 U	0.095 U	0.095 U
Benzo (a) pyrene	ug/l	0.018	0.96 U	0.097 U	0.096 U	0.097 U	0.097 U	0.098 U	0.095 U	0.098 U	0.098 U	0.097 U	0.095 U	0.095 U
Benzo (b) fluoranthene	ug/l	0.018	0.96 U	0.097 U	0.096 U	0.097 U	0.097 U	0.098 U	0.095 U	0.098 U	0.098 U	0.097 U	0.095 U	0.095 U
Benzo (ghi) perylene	ug/l	0.2	0.96 U	0.097 U	0.096 U	0.097 U	0.097 U	0.098 U	0.095 U	0.098 U	0.098 U	0.097 U	0.095 U	0.095 U
Benzo (k) fluoranthene	ug/l	0.018	0.96 U	0.097 U	0.096 U	0.097 U	0.097 U	0.098 U	0.095 U	0.098 U	0.098 U	0.097 U	0.095 U	0.095 U
Chrysene	ug/l	0.018	0.96 U	0.097 U	0.096 U	0.097 U	0.097 U	0.098 U	0.095 U	0.098 U	0.098 U	0.097 U	0.095 U	0.095 U
TPH														
Gasoline Range Hydrocarbons (Gx)	ug/l	—	1860	1430	1210	1190	2630	1680	1990	3020	2240	3780	1450	80 U
Diesel Range Organics	mg/l	—	112	1.8	1.2	1.3	8.9	1.9	1.8	7.1	8.5	5.6	3.3	0.24 U
Heavy Oil Range Hydrocarbons (Dx)	mg/l	—	4.8 U	0.48 U	0.50 U	0.49 U	0.48 U	0.48 U	0.48 U	0.48 U	0.71	0.48 U	0.48 U	0.48 U

Notes:

U: Analyte Not Detected at or above the reporting limit. Values shown are Method Reporting Limit.

J: Estimated

Values in bold are above specified JSCS SLV.

Table C.2. Comparison of Southern PEO Site Groundwater Data Against JSCS SLVs

		JSCS Table 3-1, Highlighted	MW-18 8/25/2008	MW-18 11/22/2008	MW-18 2/24/2009	MW-23 2/22/2008	MW-23 6/2/2008	MW-23 8/25/2008	MW-23 11/22/2008	MW-23 2/22/2008	MW-24 6/2/2008	MW-24 8/25/2008	MW-24 11/22/2008	MW-24 2/23/2009										
n-Propylbenzene	ug/l	—	17	3	14	65	55	52	43	J	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U				
Styrene	ug/l	100	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
Bromodichloromethane	ug/l	1.1	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
1,1,1,2-Tetrachloroethane	ug/l	2.5	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
1,1,2,2-Tetrachloroethane	ug/l	0.33	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
Tetrachloroethene	ug/l	0.12	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
Toluene	ug/l	9.8	5.0	U	1.0	U	1.5	9.3	14	9.3	15.7	J	1.0	U	1.0	U	1.0	U	1.0	U				
1,2,3-Trichlorobenzene	ug/l	—	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
1,2,4-Trichlorobenzene	ug/l	8.2	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
1,1,1-Trichloroethane	ug/l	11	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
1,1,2-Trichloroethane	ug/l	1.2	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
Trichloroethene	ug/l	0.17	5.0	U	1.5	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U			
Trichlorofluoromethane	ug/l	1300	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
Bromoform	ug/l	8.5	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
1,2,3-Trichloropropane	ug/l	0.0095	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U				
1,2,4-Trimethylbenzene	ug/l	—	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	1.3	J	1.0	U	1.0	U	1.0	U				
1,3,5-Trimethylbenzene	ug/l	—	5.0	U	1.0	U	1.0	U	6.9	5.0	5.2	4.0	J	1.0	U	1.0	U	1.0	U	1.0	U			
Vinyl chloride	ug/l	0.015	5.0	U	1.0	U	1.0	U	1.0	U	5.0	U	1.0	UJ	0.20	U	1.0	U	1.0	U	1.0	U		
o-Xylene	ug/l	13	5.0	U	1.0	U	1.0	U	5.0	U	5.0	U	2.6	J	1.0	U	1.0	U	1.0	U	1.0	U		
m,p-Xylene	ug/l	1.8	10	U	2	U	2.0	U	58	51	49	49	J	2.0	U	2.0	U	2.0	U	2.0	U			
Bromomethane	ug/l	8.7	25	U	5	U	5.0	U	25	U	25	U	5	UJ	5.0	U	5.0	U	5.0	U	5.0	U		
2-Butanone (MEK)	ug/l	7100	50	U	10	U	10	U	50	U	50	U	10	UJ	10	U	10	U	10	U	10	U		
n-Butylbenzene	ug/l	—	25	U	5	U	5.0	U	25	U	25	U	7	J	1.0	U	5.0	U	5.0	U	5.0	U		
8270 SIM																								
Acenaphthene	ug/l	0.2	1.0	0.4	1.4	1.2	1.3	0.79	1.02	0.095	U	0.097	U	0.095	U	0.095	U	0.094	U	0.094	U			
Dibenzo (a,h) anthracene	ug/l	0.018	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U		
Fluoranthene	ug/l	0.2	0.095	U	0.094	U	0.094	U	0.095	U	0.12	0.095	U	0.097	U	0.095	U	0.095	U	0.095	U	0.094	U	
Fluorene	ug/l	0.2	1.5	0.5	2.1	2.0	2.0	1.4	1.5	0.095	U	0.097	U	0.095	U	0.095	U	0.095	U	0.094	U	0.094	U	
Indeno (1,2,3-cd) pyrene	ug/l	0.018	0.095	U	0.094	U	0.094	U	0.095	U	0.095	U	0.097	U	0.095	U	0.097	U	0.095	U	0.095	U	0.094	U
Naphthalene (SIM)	ug/l	0.2	1.0	U	0.3	U	0.57	U	1.1	U	10	U	0.95	U	0.58	U	0.095	U	2.0	U	0.095	U	0.094	U
Phenanthrene	ug/l	0.2	1.0	0.1	1.3	1.1	1.1	0.90	0.80	0.095	U	0.097	U	0.095	U	0.095	U	0.095	U	0.094	U	0.094	U	
Pyrene	ug/l	0.2	0.095	U	0.094	U	0.094	U	0.095	U	0.19	0.095	U	0.097	U	0.095	U	0.097	U	0.095	U	0.094	U	
Acenaphthylene	ug/l	0.2	0.29	U	0.09	U	0.33	U	0.29	U	0.38	U	0.19	U	0.29	U	0.095	U	0.097	U	0.095	U	0.094	U
Anthracene	ug/l	0.2	0.095	U	0.094	U	0.094	U	0.095	U	0.095	U	0.095	U	0.097	U	0.095	U	0.097	U	0.095	U	0.094	U
Benzo (a) anthracene	ug/l	0.018	0.095	U	0.094	U	0.094	U	0.095	U	0.095	U	0.095	U	0.097	U	0.095	U	0.097	U	0.095	U	0.094	U
Benzo (a) pyrene	ug/l	0.018	0.095	U	0.094	U	0.094	U	0.095	U	0.095	U	0.095	U	0.097	U	0.095	U	0.097	U	0.095	U	0.094	U
Benzo (b) fluoranthene	ug/l	0.018	0.095	U	0.094	U	0.094	U	0.095	U	0.095	U	0.095	U	0.097	U	0.095	U	0.097	U	0.095	U	0.094	U
Benzo (ghi) perylene	ug/l	0.2	0.095	U	0.094	U	0.094	U	0.095	U	0.095	U	0.095	U	0.097	U	0.095	U	0.097	U	0.095	U	0.094	U
Benzo (k) fluoranthene	ug/l	0.018	0.095	U	0.094	U	0.094	U	0.095	U	0.095	U	0.095	U	0.097	U	0.095	U	0.097	U	0.095	U	0.094	U
Chrysene	ug/l	0.018	0.095	U	0.094	U	0.094	U	0.095	U	0.095	U	0.095	U	0.097	U	0.095	U	0.097	U	0.095	U	0.094	U
TPH																								
Gasoline Range Hydrocarbons (Gx)	ug/l	—	1433	J	581	1420	J	3930	J	4720	J	3896	J	3666	80.0	U	80	U	80	U	80	U	80	U
Diesel Range Organics	mg/l	—	2.6	1.7	3.6	3.5	2.1	2.7	4.0	0.236	U	0.24	U	0.25	U	0.24	U	0.24	U	0.24	U	0.24	U	
Heavy Oil Range Hydrocarbons (Dx)	mg/l	—	0.49	U	0.48	U	0.48	U	0.48	U	0.48	U	0.49	U	0.48	U	0.472	U	0.48	U	0.48	U	0.48	U

Notes:

U: Analyte Not Detected at or above the reporting limit. Values shown are Method Reporting Limit.

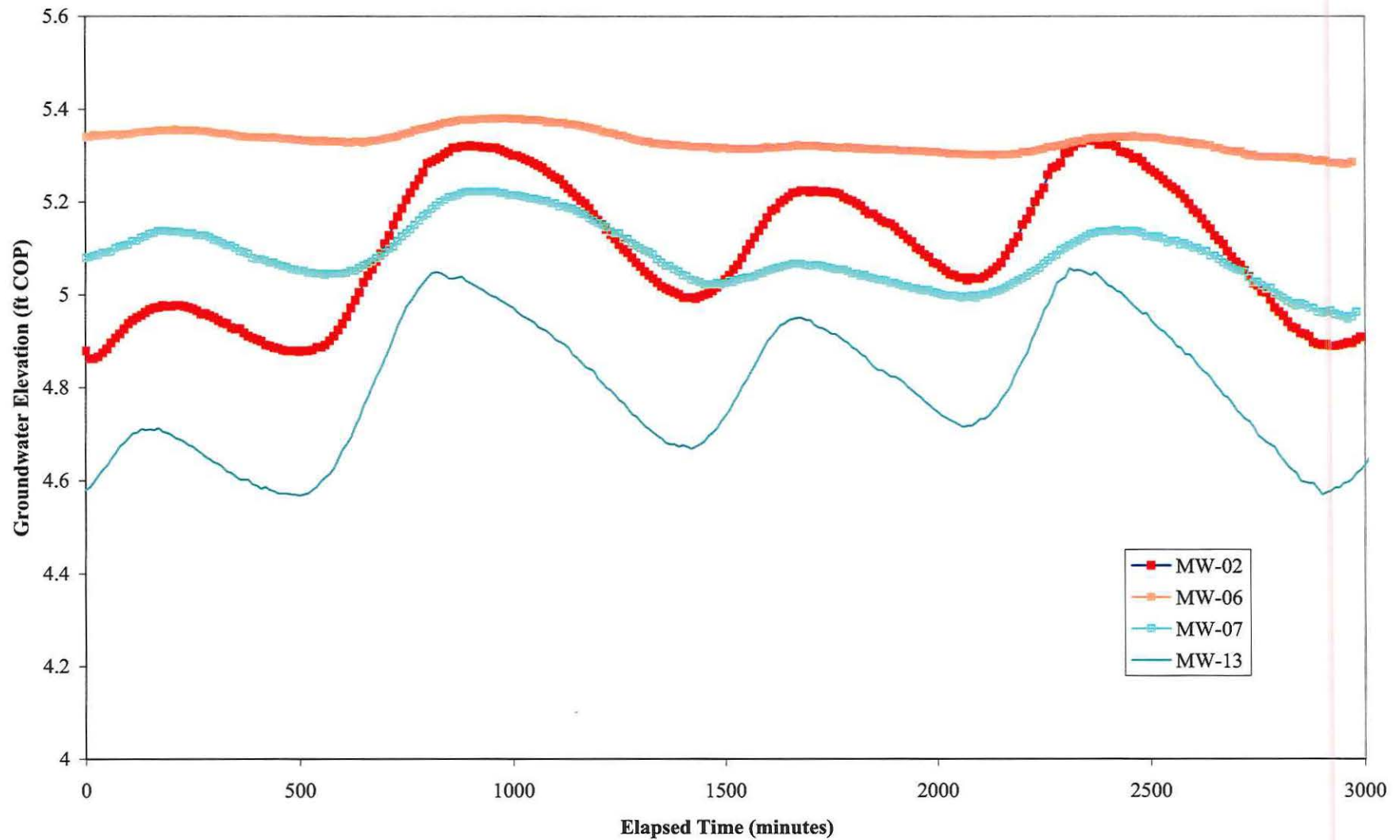
J: Estimated

Values in bold are above specified JSCS SLV.

D.1 Data Summary

Figure D.1 shows groundwater elevations collected by from shallow zone wells MW-2, MW-6, MW-7, and MW-13 from October 4 through October 10, 2001 using transducers. Transducer readings were checked against manually collected water level measurements at the start and end of the event. Tidal fluctuations in southern PEO site wells MW-2 and MW-13 range up to approximately 0.5 ft; fluctuations at central PEO site well MW-7 range up to 0.2 ft; and fluctuations are essentially indiscernible at the furthest east well, MW-06. Based on these measurements, MW-06 represents the approximate eastern limit of tidal fluctuations in shallow groundwater elevations. These data were collected by Schnitzer's subcontractor, URS Corp.

Figure D.1. Tidal Fluctuations in Groundwater Elevations Measured in Monitoring Wells in October 2001.



Groundwater elevation not corrected for LNAPL effects.
ft COP: Elevation relative to City of Portland (COP) datum